

Blackfoot Headwaters Planning Area

Water Quality and Habitat Restoration Plan and

TMDL for Sediment



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**BLACKFOOT HEADWATERS PLANNING AREA
WATER QUALITY AND HABITAT RESTORATION PLAN
AND TMDL FOR SEDIMENT**

EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify those waterbodies within its boundaries that do not meet water quality standards, to prioritize the listed waterbodies according to the severity of pollution and their intended beneficial uses, and to develop TMDLs for these waterbodies. Waterbodies are streams, lakes and wetlands, although streams are the only waterbodies determined to be impaired in the Blackfoot Headwaters Planning Area. A total maximum daily load (TMDL) is a pollutant budget establishing the maximum amount of a pollutant that a waterbody can assimilate without exceeding water quality standards. This document is a water quality and habitat restoration plan that incorporates TMDLs for sediment in the Blackfoot Headwaters TMDL planning Area. Water quality restoration planning and TMDL development for metals impairment in the Blackfoot Headwaters Planning Area is addressed in a separate document (Hydrometrics et al., 2003). Together with the metals TMDL and water quality restoration plan, this document identifies an approach to improve water quality and habitat conditions to the level where all beneficial uses are restored and protected. By fulfilling this goal, this document fulfills the requirements of Section 303(d) of the Federal Clean Water Act and Title 75, Chapter 5, Part 7 of the Montana Water Quality Act.

The Blackfoot Challenge, a grass roots watershed group, sponsored development of this plan. The water quality and habitat restoration planning efforts fit well with the mission of the Blackfoot Challenge, namely coordination of efforts to enhance, conserve, and protect the natural resources and rural character of the Blackfoot River Valley. The Blackfoot Challenge's involvement helped ensure that this plan addressed not only all sediment and habitat impairments identified by the 303(d) list, but additional habitat concerns and watershed priorities as well such as noxious weed management, fish passage mitigation, and full consideration of the links between sediment impairments and fish habitat limitations. As a result, this plan functions as both a TMDL for sediments and habitat restoration plan, as well as a general plan to improve and maintain water quality throughout the basin.

Blackfoot Headwaters Planning Area

The Blackfoot Headwaters Planning Area (Planning Area) includes the Blackfoot River watershed from its headwaters to the confluence of the Blackfoot River and Nevada Creek. The Planning Area includes approximately 318,000 acres within portions of Lewis and Clark County and Powell County in west-central Montana. The Blackfoot River has a mapped length of 61.4 miles and an average gradient of 0.98 percent through the Planning Area. Poorman Creek, Landers Fork, and Arrastra Creek are major tributaries with drainage areas ranging from 130 to 24 square miles. Beartrap Creek, Sandbar Creek, and Willow Creek (near Flesher Pass) are all smaller drainages addressed in this document. All surface waters within the Planning Area are classified as B-1 waters (ARM 17.30.607). B-1 classified waters are intended to be suitable for drinking, culinary and food processing purposes after conventional treatment; bathing,

swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply (ARM 17.30.623).

Summary of Impairments

Table E-1 lists all waterbodies, or stream segments, identified on the 1996 and/or 2002 303(d) list as impaired, along with the listed causes of impairment (i.e., sediment, habitat degradation). Stream segments listed as impaired due to siltation in 1996 and/or 2002 include the Blackfoot River between Landers Fork and Nevada Creek, Arrastra Creek, Poorman Creek, Sandbar Creek and Willow Creek. Waterbodies listed as impaired due to habitat alterations include the Blackfoot River from its headwaters to Landers Fork, the Blackfoot River between Landers Fork and Nevada Creek, Arrastra Creek, Poorman Creek, Sandbar Creek and Willow Creek. Other listed causes of impairment include: dewatering, flow alterations, and riparian degradation in Poorman Creek; and bank erosion in Willow Creek. All of these causes of impairment have the potential to contribute to, and compound, sediment-related impairments. Metals-related impairments are addressed in a separate water quality restoration and TMDL document (Hydrometrics et al., 2003).

Based on the 303(d) listing history, and a detailed review of existing information and additional field evaluations, four streams have been identified as being in need of TMDL development for sediment, including the Blackfoot River between Landers Fork and Nevada Creek, Arrastra Creek, Poorman Creek, and Willow Creek (Table E-1). The sediment TMDLs and habitat restoration plans for these streams address all of the siltation and habitat related causes of impairment included in Table E-1. Habitat restoration plans were also developed for Sandbar Creek, Beartrap Creek, Mike Horse Creek, and the Blackfoot River from the headwaters to Landers Fork (upper one mile only) to address habitat related causes of impairment where development of a sediment TMDL was not required. Therefore, this document includes sediment TMDLs and habitat restoration plans for a total of four waterbodies and eight waterbodies, respectively. In addition to the causes of impairment listed in Table E-1 and described above, other non TMDL-related impediments to beneficial use support (and thus potential water quality impairments), such as undersized culverts which impede fish migration, are addressed as part of habitat restoration planning.

Data Collection and Assessment Methods

Development of the Blackfoot headwaters restoration plan and sediment TMDLs followed a phased approach to data collection and assessment. The Phase I assessment included a review and compilation of existing information on the Blackfoot Headwaters watershed (Confluence and DTM, 2000). Water quality and aquatic biological data were compiled and reviewed to evaluate current physical and impairment-related stream conditions. Geographical, physical and land-use information on the watershed was compiled and reviewed for use in TMDL planning. Finally, a GIS-based geomorphic risk assessment (GRA) model was developed in the Phase I assessment for identification of potential sediment loading sources and linkages of impairment to these sources. The GRA model incorporated biological and physical basin characteristics compiled during the Phase I assessment. The Phase I assessment was used for TMDL and restoration planning, with several components of the assessment incorporated into this document.

Table E-1. Summary of Waterbodies in Need of Sediment TMDL and/or Habitat Restoration Plan in the Blackfoot Headwaters Planning Area.

Waterbody	Stream Segment Number	Stream Miles	Causes of Impairment		Water Quality Plans Developed
			1996 303(d) List	2002 303(d) List	
Blackfoot River from Headwaters to Landers Fork	MT76F001-010	16.4	Metals, Other habitat alterations	Metals, Other habitat alterations	Habitat Restoration Plan for upper 1 mile
Blackfoot River from Landers Fork to Nevada Ck	MT76F001-020	48.3	Other habitat alterations, Siltation	Other habitat alterations, Siltation	Sediment TMDL/Habitat Restoration Plan
Arrastra Creek	Mt75f002-070	12.6	Not assessed	Other habitat alterations, Siltation	Sediment TMDL/Habitat Restoration Plan
Beartrap Creek from Mike Horse Creek to mouth	MT76F002-040	0.5	Metals	Metals	Habitat Restoration Plan
Mike Horse Creek	Number Not Yet Assigned	0.6	Not listed	Not listed	Habitat Restoration Plan
Poorman Creek	MT76F002-030	14.0	Dewatering, Flow alterations, Metals, Other habitat alterations, Riparian degradation, Siltation	Dewatering, Flow alterations, Metals, Other habitat alterations, Riparian degradation, Siltation	Sediment TMDL/Habitat Restoration Plan
Sandbar Creek	MT76F002-060	1.6	Not assessed	Copper, Metals, Other habitat alterations, pH, Siltation	Habitat Restoration Plan
Willow Creek	MT76F002-020	2.8	Bank erosion, Other habitat alterations,	Bank erosion, Other habitat alterations, Siltation	Sediment TMDL/Habitat Restoration Plan

The Phase I assessment was followed by an aerial photography evaluation of the Planning Area. Objectives of the assessment included delineation of individual stream reaches with similar geomorphic properties, identification of potentially impaired stream segments, assessment of riparian cover, and evaluation of channel migration rates.

A Phase II field assessment was completed in August 2002 for the purpose of filling data gaps identified in Phase I, documenting sources of sediment loading and habitat alterations, and collecting specific data required for establishing restoration targets and load allocations. The Phase II assessment included three general components:

- Reconnaissance of conditions in 303(d)-listed stream segments;
- A bank erosion inventory and Blackfoot River geomorphic assessment;
- A physical habitat assessment of “typical” or “potentially impaired” reaches as identified through the aerial photography assessment, using a modified Environmental Monitoring and Assessment Program (EMAPS) method. Information on percent of surficial fine sediment in-stream substrate; riparian structure and composition; bank full dimensions; volume of woody debris; and degree of human influence was recorded during the physical habitat assessment.

The Phase II assessment also identified and evaluated potential reference stream reaches for use in establishing restoration targets.

Other site-specific assessments and evaluations completed in support of TMDL and restoration plan development include:

- A road sediment analysis utilizing a sediment yield model developed by the USFS and Plum Creek Timber Company for select forest roads. The previously developed model was applied to roads throughout the headwaters Planning Area to estimate sediment loading from roads to impaired stream segments.
- An analysis of sediment loading to impaired streams due to road traction sanding. This analysis incorporated information on the proximity of sanded roads to streams, sand application rates, and roadbed and road ditch gradients.
- Development of a Sediment Source and Delivery Model (SSDM) for upland areas. The SSDM model was an extension of the GRA model developed in the Phase I assessment and was used to delineate areas within the watershed prone to erosion and accelerated sediment delivery to surface waters. The model incorporated information on slope, soil erodibility, vegetative cover, and precipitation.
- Estimation of sediment loading from eroding stream banks using Phase II field results, with delineation of percent attributable to human sources.
- An assessment of human influences on the geomorphology, sediment yield and water yield in Landers Fork drainage. Although not listed as impaired, Landers Fork received considerable attention due to its strong influence on the geomorphology of, and the significant sediment load (primarily natural in origin) it introduces to the Blackfoot River.

In addition to the current assessments and investigations, results of several previous studies and information sources were incorporated into the Blackfoot Headwaters Planning Area water quality and habitat restoration plan and sediment TMDL including:

- Stream substrate composition data from McNeil Core sediment samples collected by the USFS at numerous locations over a 15 year period;
- A 1996 fish habitat survey conducted by the USFS in Arrastra Creek drainage;
- Investigations of roads in Poorman Creek drainage performed by USFS as part of a vegetation management EIS. The road investigations included, among other things, estimates of sediment contribution rates from roads, and identification of undersized culverts;
- Assessments by Montana DEQ through their sufficient credible data/beneficial use support (SCD/BUD), including evaluations of periphyton and macroinvertebrate community compositions.

Current Conditions and Sediment Loading Sources

Based on the analyses performed, primary sources of sediment loading to streams in the Blackfoot Headwaters Planning Area include sediment from road runoff, road traction sanding, eroding stream banks, and erosion from upland areas. Following is a listing of water quality and habitat conditions documented in the impaired stream segments (Table E-2).

Blackfoot River Upstream of Landers Fork

- Biological data indicates impairment mainly attributable to metals.
- Field assessment indicates good habitat conditions, except in the upper mile where mining activities and a tailings dam breach have impacted the stream channel and riparian habitat.

Blackfoot River from Landers Fork to Nevada Creek

- Biological data indicates both metals and siltation-related impairment. Although indications of metals-related impairment decrease with downstream distance, historic data indicates that sediment-related impairments persist all the way downstream to the confluence with Nevada Creek.
- Physical habitat assessment results show that total sediment loading from Landers Fork, due primarily to natural sources, creates a coarse sediment, braided channel upstream of Lincoln. Streambed sediments become much finer downstream between Lincoln and Nevada Creek, where the river consists of a single channel.
- Sediment loading from eroding stream banks is significant throughout this stream reach, with a total yearly average sediment delivery of 34,400 tons/year. However, only about 5,200 tons/year, or 15%, is attributable to non-natural stream bank sources associated with preventable human-caused loading. Of this human-caused loading rate, 50% is attributable to grazing, 24% to roads, with lesser amounts attributed to logging, buildings, revetments, and other relatively minor causes.

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- Traction sanding of Highway 200 contributes approximately 12tons/year of sand to the Blackfoot River and a tributary to the Blackfoot River.
 - Hillslope erosion was also identified as a potentially significant source of sediment loading within the Blackfoot River watershed, although these rates could not be accurately quantified.
 - Sediment delivery from roads due to erosion was determined through modeling to be about 700 tons per year, of which at least 30% could be controlled via implementation of forest road BMPs.
 - Many of the above sources contribute sediment to this segment of the Blackfoot River via tributary drainages.

Arrastra Creek:

- Results of the 2002 Phase II Physical Assessment, as well as previously collected information and data, indicate that physical habitat is impaired due to excess fine sediment (siltation), and excess sediment bed load (aggradation). Siltation is more pronounced in the downstream reach.
- Runoff from roads is estimated to contribute 19 tons/year of sediment to Arrastra Creek and tributaries. Other sediment loading sources include eroding banks and hillslope erosion from harvesting and/or grazing, although these sources could not be accurately quantified.

Poorman Creek:

- Documented habitat impairments within Poorman Creek drainage include streambed sedimentation from various sediment loading sources, undersized and poorly designed culverts, and channel alterations due primarily to historic placer mining operations in the lower stream reaches. Roads are estimated to contribute 22 tons of sediment per year to Poorman Creek. Other sediment loading sources include eroding banks and hillslope erosion associated with harvesting and/or grazing, although these sources could not be accurately quantified. Dewatering also negatively impacts aquatic life in the lower reach of this stream.

Willow Creek:

- Road encroachment and past livestock grazing practices have impacted the physical habitat in Willow Creek, although livestock grazing may no longer be a significant source of habitat impairment at the most impacted sub-reach.
- Sediment loading from road runoff is estimated to be 15 tons/year, with road traction sanding providing an additional 3 tons/year. Other sediment loading sources include eroding banks and hillslope erosion from timber harvesting and/or grazing, although these sources could not be accurately quantified.

Sandbar Creek:

- Habitat alterations within Sandbar Creek drainage are primarily related to historic mining activities. In addition to introducing metals to surface waters and stream sediments, mine waste piles located along the drainage bottom act as a source of habitat degradation. Therefore, water quality restoration goals developed within this plan are linked to remediation efforts within the Blackfoot Headwaters metals TMDL (Hydrometrics et al, 2003). Another source of habitat related impairment is channelization where Sandbar Creek crosses Highway 279.

Beartrap and Mike Horse Creeks:

- As with Sandbar Creek, habitat alterations in Beartrap Creek and Mike Horse Creek are related to historic mining activities. Therefore, water quality restoration goals developed within this plan are linked to remediation efforts within the Blackfoot Headwaters metals TMDL.

Restoration Targets and Allocations

Based on the assessment of current conditions, water quality and habitat restoration goals and targets were established for each stream segment in need of a sediment TMDL. Targets were also established for restoration of habitat-related impairments that are not addressed through the sediment TMDLs, such as non-natural barriers to fish migration. Restoration targets for biological communities and stream substrate composition have been established for all of these stream segments, including the Blackfoot River between Landers Fork and Nevada Creek, Arrastra Creek, Poorman Creek, Willow Creek, Sandbar Creek, Beartrap Creek, Mike Horse Creek, and the upper mile of Blackfoot River (Table E-2). The biological targets include attainment of fully supporting conditions for macroinvertebrate and periphyton communities, and clinger taxa richness greater than or equal to 14. The stream substrate targets include upper limits on the allowable percentage of fine-grained sediments within the stream substrate, with no more than 15% of stream sediments being less than 2.38 mm in size, and no more than 29% less than 6.35 mm. Additional restoration targets were established in most of the streams based on the specific impairment causes and/or sources identified on the 303(d) list through restoration plan and TMDL development. These stream-specific targets range from establishment of minimum percentages of desirable riparian cover and limits on maximum channel width to depth ratios in several stream segments, to development of dynamically stable stream channel configurations in portions of Poorman Creek subject to historic placer mining activities.

Based on the restoration targets and sediment TMDLs, allocations were applied to the individual impairment sources or source categories. In some cases, allocations are quantitative in nature with specific limits placed on source contributions or specific requirements established for source load reductions. For example, the sediment TMDL for Poorman Creek requires 30% and 75% reductions in sediment loading rates from roads and from human-caused bank erosion, respectively. For other sources such as road sanding, performance-based allocations have been applied based on implementation of acceptable management practices to reduce sediment loading. In addition, land use indicators that could lead to establishment of future allocations are

applied to address potential future impacts from increased water yield and increased hillslope erosion. The allocations, in conjunction with the implicit margins of safety incorporated into the program, constitute the sediment TMDLs for the sediment-impaired streams.

Implementation Strategy

The water quality and habitat restoration plan includes an implementation plan, or strategy, designed to ensure that restoration targets are ultimately met. The implementation strategy encompasses a wide range of proposed restoration actions as well as land use and management guidelines. The implementation strategy includes basin-wide strategies designed to meet general restoration targets and improve overall watershed health (Table E-2). The implementation strategy also includes stream-specific strategies intended to address observed impairments in each stream segment in need of TMDL and/or restoration plan development. To a large extent, the implementation strategies rely on voluntary participation by landowners and other basin stakeholders.

Due to its considerable length, the listed segment of the Blackfoot River (from Landers Fork to Nevada Creek) was separated into seven individual stream reaches, based on geomorphic form and processes, to facilitate implementation planning in this stream segment.

Basin-wide implementation strategies include:

- Management of land-use activities on erosion-prone hillsides;
- Implementation of basin-wide road improvements and enhanced road BMPs in coordination with ongoing USFS efforts;
- Management of noxious weeds;
- Development and implementation of grazing BMPs;
- Water conservation and maintenance of in-stream flows;
- Conservation of intact landscapes;
- Revegetation of stream banks and riparian zones to promote bank stability, and provide shade and large woody debris to streams;
- Adoption of riparian buffer zones to minimize encroachment and development into riparian zones and allow for natural channel migration processes; and,
- Removal of fish passage barriers, such as undersized culverts.

In addition to the basin-wide strategies, site-specific restoration strategies identified for individual stream segment corridors include:

- Blackfoot River from headwaters to Nevada Creek:
 - Road maintenance and development of grazing BMPs on the Blackfoot River extending from near the town of Lincoln downstream to near the Highway 141 bridge crossing (approximately 24 miles). Based on a prioritization of the Blackfoot River subreaches, this portion of the Blackfoot River exhibits the greatest level of impairment and highest level of eroding banks, with grazing and road encroachment identified as the primary sources of impairment;

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- Integration of channel and habitat restoration activities into currently scheduled reclamation actions proposed for the upper one-mile of the Blackfoot River as described in the Blackfoot Headwaters metals TMDL (Hydrometrics et al., 2003);
 - A combination of measures designed for stream bank stabilization and mitigation of other sediment sources, riparian vegetation enhancement, and stream channel restoration/ fish habitat enhancement in other reaches of the Blackfoot River.
 - Arrastra Creek: Noxious weed management, establishment of riparian buffer zones and healthy riparian vegetative cover, and replacement of undersized culverts which affect fish migration and limit the stream's sediment transport potential;
 - Poorman Creek: Noxious weed management, removal of fish passage barriers, development and implementation of riparian grazing BMPs, maintenance of in-stream flows, and restoration of placer mined portions of the creek subject to findings of a cost-benefit analysis;
 - Willow Creek: Noxious weed management, continued implementation and possible refinement of riparian grazing BMPs, mitigation of road encroachment;
 - Sandbar Creek: Mitigate road encroachment at Highway 279 crossing, incorporate channel restoration into proposed mine reclamation activities identified in the metals TMDL;
 - Beartrap Creek and Mike Horse Creek: Incorporate channel restoration into proposed mine reclamation activities identified in the metals TMDL.

Implementation strategy coordination will be a cooperative effort, with the Blackfoot Challenge, DEQ, MDNRC, USFS, and other state and federal land management agencies and stakeholders involved. These strategies will be implemented through existing water quality and land management programs, either grass roots or regulatory in nature, such as the Montana Natural Streambed and Land Preservation Act and Floodplain Management Act. Strategies will also be implemented through cooperative agreements with landowners and stakeholders, as spearheaded by the Blackfoot Challenge. Ultimately, the implementation strategy is intended to result in full attainment of the restoration targets and designated beneficial uses, as well as improve the overall health of the watershed. Finally, an adaptive management approach will be adopted for the implementation strategy where results of ongoing monitoring are used to evaluate the success of implementation efforts, and modifications made to restoration goals, load allocations, and implementation strategies as appropriate.

Monitoring Strategy

Based on the existing conditions, restoration targets, and the implementation strategies developed in this plan, a conceptual water quality monitoring plan, or monitoring strategy, was developed. The monitoring program is intended to provide feedback on restoration activities performed under the implementation strategy program, as well as information on general watershed health and trends. The monitoring strategy includes two main categories: "Implementation Monitoring"; and "Additional Assessment and Watershed Characterization Monitoring". The objectives of the Implementation Monitoring program are to: 1) assess progress toward ultimate attainment of the restoration targets; 2) assess overall progress toward meeting load allocations; and 3) assess the effectiveness of specific restoration activities completed under the water quality and habitat restoration plan. Preliminary sampling locations

and schedules for Implementation Monitoring are included for each stream in need of TMDL or habitat restoration plan development, with the sampling parameters for each stream segment based on applicable impairments and restoration targets (Table E-2). For instance, the Blackfoot River segment from Landers Fork to Nevada Creek will be monitored for macroinvertebrate and periphyton community health and substrate composition to assess attainment of the associated restoration targets established for this stream segment. Implementation Monitoring results will be used to assess the progress and success of the TMDL implementation and water quality and habitat restoration program, and determine if modifications are required under the adaptive management approach to TMDL implementation.

Additional Assessment and Watershed Characterization Monitoring is presented as a prioritized list of informational and data needs that may be required for assessment of TMDL and restoration program success. These include items such as monitoring of fish populations throughout the watershed, identification of undersized or non-functioning culverts, evaluation of effects of recent forest fires in the headwaters Planning Area, and further assessment of non 303(d)-listed streams which may in fact be impaired due to habitat and sediment-related conditions (i.e., Moose and Sauerkraut creeks). The Additional Assessment and Watershed Characterization Monitoring program will be overseen by the Blackfoot Challenge, and in most cases will incorporate and/or augment ongoing monitoring activities such as the Department of Fish Wildlife and Parks' fish population survey program. Although not specifically required under the TMDL laws, these basin-wide monitoring efforts will provide a greater understanding of the watershed health as a whole, and thus will serve as indirect measures of implementation and restoration program successes in meeting the overall TMDL goals and requirements.

Table E-2. Sediment and Habitat Restoration Plan Summary.

Stream Segment/ Stream Miles	Probable Causes of Impairment (1996 and 2002 Lists)	Existing Probable Sources of Sediment and Habitat Alteration Impairments	Beneficial Uses Not Fully Supported Due to Sediment or Habitat Alterations	Sediment and/or Habitat Related Impairments Confirmed Through Sediment TMDL and Habitat Restoration Planning Efforts	Sediment and Habitat Target Conditions	Allocations or Prescribed Conditions to Meet Water Quality Standards for Sediment and Habitat Alterations	Restoration Activities
Blackfoot River (Headwaters to Landers Fork) 16.4 miles	<ul style="list-style-type: none"> Metals Nutrients Other Inorganics Habitat Alteration Siltation 	<ul style="list-style-type: none"> Mining 	<ul style="list-style-type: none"> Cold-water fish Aquatic life 	<ul style="list-style-type: none"> Habitat Alterations (in uppermost mile) 	<ul style="list-style-type: none"> Restoration of channel morphology Healthy aquatic invertebrate & periphyton communities 	<ul style="list-style-type: none"> Restoration of physical stream habitat, channel morphology and fully functioning riparian area 	<ul style="list-style-type: none"> Watershed-wide management activities River Corridor management activities Habitat Restoration Plan for upper 1 mile
Blackfoot River (Landers Fork to Nevada Creek) 48.3 miles	<ul style="list-style-type: none"> Metals Siltation Suspended Solids Other habitat Alterations 	<ul style="list-style-type: none"> Agriculture Timber Harvest Highway Maintenance Roads 	<ul style="list-style-type: none"> Cold-water fish Aquatic life 	<ul style="list-style-type: none"> Siltation Habitat Alterations 	<ul style="list-style-type: none"> Reduced levels of fine sediment on the streambed Healthy aquatic insect & periphyton communities 	<ul style="list-style-type: none"> Reduced contributions of fine sediment from: <ul style="list-style-type: none"> Eroding banks Roads Road Sanding 	<ul style="list-style-type: none"> Watershed-wide management activities River corridor management activities Sediment TMDL - Mgt of eroding banks
Arrastra Creek 12.6 miles	<ul style="list-style-type: none"> Flow alteration Habitat Alteration Siltation 	<ul style="list-style-type: none"> Agriculture Roads Bank Modification Timber Harvest 	<ul style="list-style-type: none"> Cold-water fish Aquatic life 	<ul style="list-style-type: none"> Siltation Habitat Alterations 	<ul style="list-style-type: none"> Healthy aquatic invertebrate & periphyton communities Decreased levels of fine sediment on the streambed Restoration of channel morphology Healthy riparian community 	<ul style="list-style-type: none"> Reduce sediment contributed from: <ul style="list-style-type: none"> Roads In channel sources Degraded riparian areas 	<ul style="list-style-type: none"> Watershed-wide management activities River corridor management activities Sediment TMDL - Management activities associated with habitat and riparian conditions
Beartrap Creek 0.5 mile	<ul style="list-style-type: none"> Metals 	<ul style="list-style-type: none"> Mining 	<ul style="list-style-type: none"> Cold-water fish Aquatic life 	<ul style="list-style-type: none"> Habitat Alteration 	<ul style="list-style-type: none"> Restoration of channel morphology Healthy aquatic invertebrate & periphyton communities 	<ul style="list-style-type: none"> Restoration of physical stream habitat, channel morphology and fully functioning riparian area 	<ul style="list-style-type: none"> Watershed-wide management activities River corridor management activities Mgt activities associated with habitat and riparian conditions

Table E-2. Sediment and Habitat Restoration Plan Summary.

Stream Segment/ Stream Miles	Probable Causes of Impairment (1996 and 2002 Lists)	Existing Probable Sources of Sediment and Habitat Alteration Impairments	Beneficial Uses Not Fully Supported Due to Sediment or Habitat Alterations	Sediment and/or Habitat Related Impairments Confirmed Through Sediment TMDL and Habitat Restoration Planning Efforts	Sediment and Habitat Target Conditions	Allocations or Prescribed Conditions to Meet Water Quality Standards for Sediment and Habitat Alterations	Restoration Activities
Mike Horse Creek 0.6 mile	<ul style="list-style-type: none"> • Not Listed 	<ul style="list-style-type: none"> • Mining 	<ul style="list-style-type: none"> • Cold-water fish • Aquatic life 	<ul style="list-style-type: none"> • Habitat Alteration 	<ul style="list-style-type: none"> • Restoration of channel morphology • Healthy aquatic invertebrate & periphyton communities 	<ul style="list-style-type: none"> • Restoration of physical stream habitat, channel morphology and fully functioning riparian area 	<ul style="list-style-type: none"> • Ongoing mine reclamation program associated with Upper Blackfoot Mining Complex • Watershed-wide mgt activities • River corridor management activities • Mgt activities associated with habitat and riparian conditions
Poorman Creek 14.0 miles	<ul style="list-style-type: none"> • Metals • Habitat Alteration • Riparian Degradation • Siltation • Flow Alteration 	<ul style="list-style-type: none"> • Agriculture • Timber Harvest • Roads 	<ul style="list-style-type: none"> • Cold-water fish • Aquatic life 	<ul style="list-style-type: none"> • Habitat Alterations • Siltation 	<ul style="list-style-type: none"> • Healthy aquatic invertebrate and algae communities • Decreased levels of fine sediment on the streambed • Channel restoration in placer mined reaches • Maintenance of in-stream flows • Removal of barriers to desirable fish migration 	<ul style="list-style-type: none"> • Reduce fine sediment contributed from: <ul style="list-style-type: none"> ◦ Roads ◦ Eroding banks ◦ Dewatering • Restoration of physical stream habitat, channel morphology and fully functioning riparian area 	<ul style="list-style-type: none"> • Watershed-wide mgt activities • River corridor mgt activities • Sediment TMDL - Mgt activities associated with habitat and riparian conditions
Sandbar Creek 1.6 miles	<ul style="list-style-type: none"> • Metals • pH • Habitat Alteration • Siltation 	<ul style="list-style-type: none"> • Mining • Channelization • Roads 	<ul style="list-style-type: none"> • Cold-water fish • Aquatic life 	<ul style="list-style-type: none"> • Habitat Alterations 	<ul style="list-style-type: none"> • Restoration of channel morphology • Healthy aquatic invertebrate & periphyton communities 	<ul style="list-style-type: none"> • Restoration of physical stream habitat, channel morphology and fully functioning riparian area 	<ul style="list-style-type: none"> • Ensure completion of metals-related restoration activities • Watershed-wide mgt activities • River corridor mgt activities • Mgt activities associated with habitat and riparian conditions
Willow Creek 2.8 miles	<ul style="list-style-type: none"> • Metals • Bank Erosion • Habitat Alteration • Siltation 	<ul style="list-style-type: none"> • Agriculture • Roads • Highway Maintenance 	<ul style="list-style-type: none"> • Cold-water fish • Aquatic life 	<ul style="list-style-type: none"> • Habitat Alterations • Siltation 	<ul style="list-style-type: none"> • A restored, functioning channel and riparian area • Healthy aquatic insect & algae communities • Decreased levels of fine sediment on the streambed • Removal of barriers to desirable fish migration 	<ul style="list-style-type: none"> • Restoration of physical stream habitat, channel morphology and fully functioning riparian area. • Reduced contributions of fine sediment from: <ul style="list-style-type: none"> ◦ Eroding banks ◦ Roads ◦ Road Sanding 	<ul style="list-style-type: none"> • Watershed-wide mgt activities • River corridor mgt activities • Sediment TMDL - Mgt activities associated with eroding banks

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SECTION 1.0

INTRODUCTION

This document is a water quality and habitat restoration plan (WQHRP) and total maximum daily load (TMDL) submittal for sediment related impairments in the Blackfoot Headwaters Planning Area (Figure 1). The primary objective is to develop an approach to restore and maintain the physical, chemical, and biological integrity of streams in the sub-basin. Restoration and maintenance of these aspects of the integrity of the nation's waters is the objective of the Clean Water Act, which requires the development of TMDLs. Furthermore, attaining this level of watershed function will ensure full support of beneficial uses consistent with Montana Water Quality Act. The focus of this document is on habitat alterations and sediment related impacts; a separate effort addressed impairment associated with metals (Hydrometrics et al., 2003).

The Blackfoot Headwaters Planning Area contains six stream segments listed on Montana's 2002 list of impaired waters with probable causes of impairment that are associated with sediment-related pollutant conditions, including various habitat alterations. An additional two stream segments, Mike Horse Creek and Beartrap Creek, have since been identified as impaired due to habitat alterations. Montana State law defines an impaired water as a water or stream segment for which sufficient, credible data indicate that the water or stream is failing to achieve compliance with applicable water quality standards (Montana Water Quality Act, Section 75-5-103). Compilation of this list by states is a requirement of section 303(d) of the Federal Clean Water Act. Both state law and the Clean Water Act require development of TMDLs for waters on this list where sediment pollution results in impairment. This plan also includes restoration strategies where habitat or other conditions impair a beneficial use but a clear link to sediment or any other pollutant is lacking.

TMDL development and water quality restoration planning is essentially a problem-solving process. The first steps include assessment of the health of 303(d) listed streams and identification of causal mechanisms responsible for impairment. Numerical targets provide the basis of determining the degree to which stream conditions depart from desired conditions. Numerical allocations are developed to apportion the pollutant reduction needed across the watershed. Based on these analyses, watershed planners, in collaboration with stakeholders, develop a strategy or set of solutions to remedy the identified problems. The result is a plan to restore the bodies of water to a condition that meets Montana's water quality standards and support of designated beneficial uses. This document exceeds both state and federal requirements for TMDL development by dovetailing these activities into a more comprehensive water quality and habitat restoration plan for the Blackfoot Headwaters Planning Area.

According to Montana State Law, development of TMDLs is ultimately the responsibility of the Montana Department of Environmental Quality (DEQ); however, local involvement in the process ensures protection of stakeholder interests and increases the overall quality, acceptance, and ongoing implementation of the plan. In 2001, DEQ requested the Blackfoot Challenge help in developing TMDL plans for the Blackfoot Headwaters Planning Area. The Blackfoot Challenge, a local, grass roots group consisting of private landowners, federal and state agency representatives, local government officials and corporate landowners, in cooperation with other partners in the watershed, agreed to take the lead.

The Blackfoot Challenge decided to create a Blackfoot Headwaters Habitat and Water Quality Restoration Plan. The purpose of the plan was to provide a framework within which a wide array of habitat protection and restoration activities will be coordinated within the private-public partnership. A key component of this plan is the development of sediment TMDLs that address water quality issues associated with state listed impaired streams. The Blackfoot Challenge hired Confluence Consulting, Inc. and their TMDL planning partners (DTM Consulting and Applied Geomorphology, Inc.) to assist in the development of the plan. Substantial in-kind contributions from agencies, private sources, and a DEQ 319 grant funded this effort. From December 2001 through November 2003, the Blackfoot Challenge Habitat and Water Quality Restoration Committee (Appendix A) collaborated with DEQ and the contractors. The goal of employing this multiparty, interdisciplinary approach was to produce a plan that provides a better understanding of the Blackfoot headwaters, the issues, and opportunities for protection and restoration of the natural resources important to the health and vitality of the Blackfoot watershed.

While TMDL development is currently a driving force behind water quality planning efforts in the Blackfoot Headwaters Planning Area, the Blackfoot Challenge seeks to address other natural resource concerns in the basin. The goal of this plan is to provide a framework for the protection and restoration of the natural resources and the rural lifestyles that these resources support. The Blackfoot Challenge seeks to meet these objectives through education, land and water stewardship, and habitat restoration. Specific actions to achieve this objective include:

- Promote understanding of stream dynamics and impacts from human activities;
- Promote healthy riparian habitat through stream setbacks, floodplain management, riparian buffers, and riparian vegetation management;
- Promote alternatives to riprap and other bank armoring;
- Foster grazing, timber harvest, and road best management practices (BMPs);
- Control noxious weeds;
- Work with individual landowners on land stewardship; and
- Implement a long-term habitat restoration program.

An important consideration in this TMDL planning effort is the operational definition of the term restoration. Restoration, as it is used in this document, refers to any activity that promotes attainment of water and habitat quality objectives. A range of strategies fall within the concept of restoration including best management practices (BMPs), revegetation, riparian setbacks, addition of large woody debris, and mechanical channel alterations. Restoration activities will vary by stream and will reflect a number of factors such as severity of impairment aquatic species likely to benefit, and expected level of benefit.

Addressing issues of seasonality is an important consideration in sediment TMDL planning efforts. Some sediment and related habitat impairments vary in their severity with season. For example, flow is a considerable influence on siltation with scouring of fines occurring during spring runoff and accumulations occurring during low flows. Despite seasonal variations, in-stream conditions need to ensure beneficial use support throughout the year.

This plan incorporates seasonality through several ways. First, the US Forest Service monitors substrate composition based on timing of spawning for the species of concern to ensure that core samples represent recent spawning locations. Bull trout spawning areas are monitored during the fall and westslope cutthroat trout streams are monitored during early summer. Furthermore, the index period for developed for macroinvertebrate and periphyton also has a built in mechanism for addressing seasonality. The index period begins following spring runoff and extends through September. This captures the period when conditions are likely to be most stressful to aquatic life. For example, low flows during this time will result in accumulation of fine sediment. Furthermore, other stressful conditions associated with riparian and habitat degradation such as warm water temperatures is more pronounced in this period. Note that this has significant influence on aquatic macroinvertebrates as insects with an aquatic life stage evolved in cold headwater streams (Ward and Stanford, 1982). Therefore, warmer temperatures may be constraint to those species that have not adapted to these conditions.

Seasonality and high flow/runoff conditions are incorporated into the sediment loading model developed to address hillslope erosion processes, models that address erosion from forest roads, evaluation of road sand loading to streams, and sediment loading estimates derived for the Landers Fork. Models that predict sediment loads from eroding banks inherently incorporate runoff flows when bank erosion is greatest. Impacts from human related flow alterations are considered from a seasonal basis. During runoff conditions, increased bank erosion or increased hillslope erosion from increases to peak flows is assessed as a potential source of increased sediment loading throughout the watershed. During low flow conditions, flow diversions that reduce baseflow conditions are assessed as a contributing factor to sediment accumulation in the lower portion of Poorman Creek.

Consideration of margin of safety is another required component of TMDL development. The margin of safety (MOS) accounts for the uncertainty about the pollutant loads and the quality of the receiving water and is intended to protect beneficial uses in the face of this uncertainty. The MOS may be applied implicitly by using conservative assumptions in the TMDL development process or explicitly by setting aside a portion of the allowable loading (EPA, 1999). This plan addresses MOS in several ways:

- Consideration of seasonality as described above;
- The adaptive management approach evaluates target attainment and allows for refinement of load allocations, targets, and restoration strategies to ensure restoration of beneficial uses;
- The sediment delivery from roads allocation is set at 30% for the Blackfoot River TMDL whereas the assessment suggests a lower reduction would satisfy the TMDL;
- An allocation is set for highway road sanding even though sediment contributions are relatively minor;
- The target setting approach for percent fines developed in Appendix G was based on a conservative assumptions regarding the set of least impaired streams to represent reference conditions;
- Multiple targets addressing biota measures and physical channel conditions are developed to address excess fines and other impairments;

- Land use indicators are added to the allocations section to help address sediment loading from future activities;
- Impairment determinations were based on conservative assumptions that favored the resource when impairments were not obvious; and
- The monitoring plan calls for evaluations of tributaries not on the 303(d) list that may contribute sediment to the Blackfoot Headwaters Planning Area.

1.1 Watershed Characterization

1.1.1 Location and Description of Watershed

The Blackfoot Headwaters Planning Area lies approximately 40 air miles northwest of Helena, Montana in west-central Montana just west of the continental divide (Figure 1). The watershed consists of the contributing area of the headwaters of the Blackfoot River watershed down to its confluence with Nevada Creek and encompasses approximately 500 square miles (318,294 acres) in Lewis and Clark and Powell counties. The Continental Divide bounds the watershed to the east and south and the Swan Range limits the northwestern extent. Elevations range from over 8000 feet in the headwaters of the Landers Fork to 4260 feet at its confluence with Nevada Creek.

Listed streams in the Blackfoot Headwaters Planning Area vary in drainage area, stream length, and gradient (Table 1-1). The main stem of the Blackfoot River in the planning area has a mapped length of 61.4 miles and an average gradient of 0.98 percent. Poorman Creek, Landers Fork, and Arrastra Creek are major tributaries with drainage areas ranging from 130 to 24 square miles. Beartrap, Sandbar, and Willow creeks are relatively small streams with a combined watershed area of about 33 square miles.

Table 1-1. Drainage Statistics for 303(d) Listed Streams in the Blackfoot Headwaters Planning Area.

Drainage Name	Area (sq mi)	Main stem Length (mi)
Arrastra Creek	23.8	12.61
Beartrap Creek	3.27	0.52
Blackfoot River MT76F001_010	115.3	14.94
Blackfoot River MT76F001_020	497.3	46.46
Landers Fork	130.8	11.63
Poorman Creek	48.0	14.02
Sandbar Creek	10.1	1.64
Willow Creek	19.34	2.80

1.1.2 Geological Setting

The Blackfoot Headwaters Planning Area consists dominantly of Proterozoic aged sedimentary rocks of the Belt Supergroup thrust eastward during the Late Tertiary Laramide orogeny (Figure 2). The majority of area consists of Proterozoic sedimentary rocks (Greyson shale, Spokane shale, Empire shale, Helena limestone; Roberts, 1986). Small amounts of Cambrian and Mississippian sedimentary rocks outcrop in the northern portion of the watershed. Cretaceous and Tertiary diorites and gabbros intrude the east central and southeast portions of the watershed and are host for many of the mineral occurrences in the area. Minor amounts of Tertiary volcanic and sedimentary rocks occur in the southern part of the watershed. Finally, Quaternary alluvium and glacial deposits cover much of the Blackfoot River and Landers Fork valley bottoms as well as much of the Beaver Creek, Stonewall Creek, and Willow Creek sub-watersheds. The headwaters of the Landers Fork deeply down cuts through this Quaternary glacial till, providing a significant natural source of fine sediment and coarse cobbles to the Landers Fork and ultimately, the Blackfoot River.

Late Cretaceous and early Tertiary intrusive activity led to the formation of numerous metallic mineral occurrences in the watershed (Figure 2). This includes occurrences of gold, silver, lead, zinc, and copper. Three major mining districts contain most of the area's historic mining activity: the Upper Blackfoot Mining Complex (UBMC) otherwise known as the Heddleston District or Mike Horse Mine, the Seven-Up Pete area, and the Swansea Mine.

1.1.3 Climate

Long, cold winters and short, moderately hot summers typify the climate of the upper Blackfoot watershed. Monthly minimum and maximum temperatures average 10.0 and 80.6 °F in January and July respectively (Table 1-2). Average annual precipitation ranges from 12.73 inches just west of the outlet of the watershed to 18.71 inches at the Lincoln Ranger Station. Higher elevations receive considerably more precipitation with the headwaters of Copper Creek averaging almost 53 inches per year (Figure 3).

Table 1-2. Climate Summary from Lincoln Ranger Station (Period of Record is from July 1948 through December 2000).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temp (°F)	29.7	36.3	43.3	53.6	63.6	71.3	80.8	80.6	69.5	55.9	38.9	31.1	54.6
Average Min. Temp (°F)	10.0	14.9	19.2	26.3	33.1	39.3	41.9	40.1	32.9	27.4	19.5	12.9	26.5
Average Total Precip (in.)	2.0	1.4	1.2	1.3	2.3	2.2	1.2	1.3	1.2	1.2	1.5	1.9	18.7

Table 1-2. Climate Summary from Lincoln Ranger Station (Period of Record is from July 1948 through December 2000).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Total Snow Fall (in.)	21.9	14.5	12.1	6.7	2.0	0.0	0.0	0.0	0.4	2.3	10.3	19.4	89.6
Average Snow Depth (in.)	14.0	16.0	12.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.0	4.0

1.1.4 Vegetation

Plant community types within the upper Blackfoot watershed are typical of higher elevation areas of the Rocky Mountains ecoregion. Vegetation classes most abundant include lodgepole pine, mixed subalpine forest, low/moderate cover grasslands, and Douglas fir (Table 1-3). Forested vegetation types occur mainly in higher elevations with grasslands dominating in valley portions in the watershed (Figure 4).

Table 1-3. Percent Area of Vegetation Types Occurring in the Blackfoot Headwaters Planning Area.

Vegetation Cover Type	Percent Area
Lodgepole Pine	18.47
Mixed Subalpine Forest	15.72
Low/ Moderate Cover Grasslands	12.06
Douglas-Fir/ Lodgepole Pine	11.58
Douglas-Fir	11.36
Mixed Mesic Shrubs	5.94
Mixed Xeric Forest	5.11
Standing Burnt Forest	3.44
Mixed Whitebark Pine Forest	2.66
Mixed Mesic Forest	2.44
Montane Parklands & Subalpine Meadows	1.94
Conifer Riparian	1.57
Mixed Broadleaf Forest	1.41
Shrub Riparian	1.26
Rock	1.10
Mixed Riparian	0.60
Ponderosa Pine	0.43
Moderate/ High Cover Grasslands	0.43
Western Larch	0.40
Agricultural Lands – Irrigated	0.38
Mixed Barren Sites	0.35
Alpine Meadows	0.30

Table 1-3. Percent Area of Vegetation Types Occurring in the Blackfoot Headwaters Planning Area.

Vegetation Cover Type	Percent Area
Mixed Broadleaf & Conifer Forest	0.21
Broadleaf Riparian	0.12
Water	0.09
Mines, Quarries, Gravel Pits	0.05
Sagebrush	0.04
Graminoid & Forb Riparian	0.04
Agricultural Lands – Dry	0.03
Urban Or Developed Lands	0.02
Mixed Broadleaf & Conifer Riparian	0.01

1.1.5 Land Ownership and Use

A mixture of public and private ownership comprises land holdings in the Blackfoot Headwaters Planning Area (Figure 5). Public lands account for the majority of the watershed with most of these lands under USFS ownership (64%), which includes “wilderness” identified in Figure 5. Plum Creek Timber Company is the next largest single landowner with approximately 6.5% of lands, while the combined holdings of other private landowners encompass 23.5% of the watershed. The State of Montana is a minor player with less than 4% ownership. USFS lands occupy higher elevations with state and Plum Creek holdings interspersed throughout. Other private holdings concentrate in lower elevation, valley portions of the watershed.

Land uses in the Blackfoot Headwaters Planning Area are typical of rural, forested watersheds in Montana (Figure 6). The dominant land uses in the watershed are livestock grazing, timber harvest, recreation, and minor dry land and irrigated agriculture. Irrigated agriculture occurs primarily in a small portion of the watershed, near Poorman Creek. Residential development is relatively minor with concentrations around Lincoln, Montana, the only town in the planning area. According to the 2000 census, Lincoln has a population of about 1,100 people. Of that number, about 600 are permanent residents and 500 reside in Lincoln seasonally (Lincoln Chamber of Commerce, personal communication).

1.1.6 Baseline Hydrology

Stream flow data from four USGS stream gage stations provide the basis for descriptions of hydrological conditions in the Blackfoot Headwaters Planning Area (Figure 3). The period of record varies considerably among these stations. USGS gauge station number 12335000 (Blackfoot River near Helmville) has the longest period of record (1940-1953) of the four stations and is closest to the outlet of the watershed at the confluence of the Blackfoot River and Nevada Creek. Stream flow measurements at the other stations covered a shorter period of record, between 2 and 4 years. Note that a more complete hydrologic record would enhance abilities to assess flow conditions and trends in the watershed.

Average monthly discharge hydrographs generated for gaging stations in the Blackfoot Headwaters Planning Area indicate that stream flows follow the pattern typical of snowmelt

driven systems (Figure 7). Peak flows occur in May and June followed by a slow decrease in flow through July and August. The relatively gradual decline of the falling limb of the hydrograph suggests that dewatering is not significant, at least not for this reach of the main stem of the Blackfoot River. These data do not provide a basis to assess dewatering on individual tributaries.

The median daily hydrograph generated for the Helmville gaging station (1233500) further characterizes stream flow characteristics in the basin (Figure 8). The data show rapidly increasing discharges in March and April with peak discharges in late May indicative of snowmelt runoff. In contrast, the average monthly discharge data show peak flows for the 1940-1953 period of record occurring in June. A review of the daily discharge data for USGS Station 12335000 revealed that several large runoff events up to 6000 cfs during June raised the average discharge but not the median above that of May. This suggests that rain-on-snow event or other large event occurred during the period of record at this gage. Note that none of the data from other hydrographs shows this trend. These large but relatively rare events may have significant influence on channel morphology in the main stem Blackfoot River.

1.1.7 Fisheries

The Blackfoot Headwaters Planning Area supports a largely native assemblage of fish comprised of eight species within four families (Table 1-4). Salmonids include the native bull trout, westslope cutthroat trout, mountain whitefish, and the introduced brook trout and brown trout. Two species of catostomid, longnose sucker and largescale sucker, occur in the upper Blackfoot watershed. The longnose dace is the sole member of the minnow family and the slimy sculpin is presumably the only member of the sculpin family occurring in the upper Blackfoot River watershed.

The Blackfoot Headwaters Planning Area has tremendous importance in the conservation and recovery of bull trout, a federally listed threatened species. The Montana Bull Trout Scientific Group (1995) identified Copper Creek and Landers Fork as core areas for bull trout due to the importance of these streams for spawning and rearing or migration to nursery areas. As a result, these areas are the focus of restoration and monitoring activities in the management of this sensitive species. Factors contributing to the decline of bull trout throughout their range include siltation and habitat degradation, increased water temperatures, introduced fish species, and barriers that restrict the movements of this highly migratory species.

Table 1-4. Fish Species Occurring in the Blackfoot Headwaters Planning Area.

Family/Common Name	Scientific Name	Introduced/ Native	Status
Salmonidae (trout, char and whitefish)			
Bull trout	<i>Salvelinus confluentus</i>	Native	Threatened
Westslope cutthroat trout	<i>Oncorhynchus clarki lewisii</i>	Native	Species of special concern
Mountain whitefish	<i>Prosopium williamsoni</i>	Native	

Table 1-4. Fish Species Occurring in the Blackfoot Headwaters Planning Area.

Family/Common Name	Scientific Name	Introduced/ Native	Status
Brook trout	<i>Salvelinus fontinalis</i>	Introduced	
Brown trout	<i>Salmo trutta</i>	Introduced	
Catostomidae (suckers)			
Largescale sucker	<i>Catostomus macrocheilus</i>	Native	
Longnose sucker	<i>Catostomus catostomus</i>	Native	
Cyprinidae (minnows)			
Longnose dace	<i>Rhinichthys cataractae</i>	Native	
Cottidae (sculpin)			
Slimy sculpin	<i>Cottus cognatus</i>	Native	

The Blackfoot Headwaters Planning Area is a stronghold for westslope cutthroat trout; another species experiencing marked declines. A major concern in the conservation of westslope cutthroat trout is the cumulative effects of siltation and introduced species on its persistence in the headwater streams, which comprise most of the remaining habitat for this species. In the presence of both brook trout and relatively high levels of fine sediment, westslope cutthroat trout face a higher risk of extirpation (Shepard et al., 1998). This underscores the need to address siltation in the conservation of westslope cutthroat trout.

Considerable efforts are underway to promote the conservation of native fish throughout the entire Blackfoot watershed. In the early 1990s, Montana Fish, Wildlife & Parks (MFWP), and the Big Blackfoot Chapter of Trout Unlimited (BBCTU) formed a partnership aimed at recovery of native fish in the Blackfoot River watershed. Initially, these efforts concentrated in the middle area of the watershed. Beginning in 1999, MFWP and BBCTU expanded their focus to include the upper Blackfoot drainage. Activities included baseline fish and habitat assessments for upper Blackfoot tributaries, identification of constraints on native fish, and monitoring in five study reaches previously sampled in 1988. These investigations resulted in identification of restoration priorities on Poorman Creek, including livestock management, conversion to sprinkler irrigation and reduction of fish loss to ditches. Implementation of these activities began in 2001. Meanwhile, evaluation of habitat and water temperatures continues in the upper Blackfoot to identify potential restoration projects benefiting recovery of native species.

In addition to sensitive, native species, the Blackfoot Headwaters Planning Area also supports high quality, recreational fishing opportunities. Montana Fish, Wildlife & Parks rates this fishery as an outstanding fisheries resource due in part to the abundance of game species and the relatively high numbers of large fish (MFISH database, <http://nr.is.state.mt.us/wis/data/fisheries.html>). Based on fishing pressure data, the uppermost 30 miles of the Blackfoot River regularly rates within the top ten streams in the upper Clark Fork sub-major basin, which includes the Bitterroot, Flint-Rock, and upper Clark Fork hydrologic units (MFISH database). Consequently, recreational fishing in the Blackfoot Headwaters

Planning Area contributes to the local economy through purchases by anglers of food, gas, and lodging.

1.1.8 Fluvial Geomorphology and Associated Conditions

Fluvial geomorphology refers to the study of the physical, morphological processes that operate within river systems and the landforms they create or have created. A number of factors influence fluvial geomorphology including basin geology, climate, vegetation, and hydrology. Because alterations in river geomorphology appear to be an issue with many 303(d) listed streams in the Blackfoot Headwaters Planning Area, characterization of fluvial processes in the basin, as described below, provides an important element supporting watershed restoration planning efforts. This section also includes description of associated features such as riparian condition and land use that may influence the geomorphic character of each stream.

As the upper Blackfoot River and its tributaries occupy headwater and main stem environments, the geomorphic character of the river system is highly variable. The uppermost reaches of the Blackfoot are typically small, moderately confined, single thread channels. At the Landers Fork confluence, the geomorphic character and size of the Blackfoot River changes markedly due to contributions of flow and coarse sediment from the Landers Fork. For the first mile downstream of the confluence, the channel is moderately confined, and thereby capable of transporting the sediment load. However, downstream of Lincoln, the channel widens significantly into a transitional meandering/braided system characterized by extensive sediment storage, lateral channel shift, and avulsion.

Downstream of Lincoln, the braided channel corridor narrows and the channel transitions back to a single thread, meandering stream. The channel gradient drops from 0.3% to approximately 0.09% as the channel enters the canyon section below Dalton Bridge. The low gradient and fine-grained perimeter sediments within and downstream of the canyon suggest historical impoundment of the river through the canyon, perhaps by an extensive series of beaver dams. Support for this supposition includes descriptions of the Blackfoot River provided in Merriweather Lewis's journals that confirm the presence of extensive beaver activity prior to the influx of European settlers. The channel has cut into those fine-grained deposits, forming a defined channel course surrounded by low terraces. The relatively narrow channel corridor results in frequent impingement of the main channel thread against the terrace margin. This results in cycling of sediment via storage of coarse sediment in bar environments and entrainment of fines from the banks. This fine material moves downstream, where it is especially deleterious to channel function and habitat value downstream of the Highway 141 Bridge.

Willow Creek is a tributary of the uppermost reach of the Blackfoot River. The channel is relatively confined, and black cottonwood, alder, willow, spruce, and lodgepole pine dominate the narrow riparian corridor. Willows exhibit indications of substantial browse pressure from wildlife in at least one location, and there are significant historical impacts, likely from livestock grazing, in the section that represents the primary reason for the impairment determination (DEQ, 2004). Heavy infestations of spotted knapweed and lesser amounts of musk thistle and Canada thistle occur on terrace environments. At the mouth of Sandbar Creek, Willow Creek consists of a wetland complex characterized by pools, multiple channels, and dense riparian

vegetation. Downstream, to the Blackfoot River confluence, woody debris accumulations are common, and debris jams occur locally.

Mining activities are a significant impact on Sandbar Creek, a tributary of Willow Creek. Mine tailings border the banks in the upper reaches and iron hydroxide covers much of the stream substrate. Near its mouth, the Highway 279 embankment channelizes approximately 200 ft of Sandbar creek. Conditions occurring in this segment include bank failure, flow impoundment, and loss of cross sectional definition.

Poorman Creek is a major tributary of the Blackfoot River, joining the Blackfoot just downstream of Lincoln. Headwater channels within the Poorman Creek watershed are confined, relatively steep, and stable. Black cottonwood occurs in the riparian zone, along with conifer, willow, dogwood, and alder. In middle reaches, historic placer mining was extensive, and the channel flows through placer spoil piles, as well as locally confined canyon sections. In some segments influenced by placer mining, the channel has short aggradational reaches, and high width-to-depth ratios. In other sections, the channel has down cut into spoils, although these incised channel segments tend to be well vegetated and relatively stable. Encroachment of residences, livestock grazing, and dewatering all have an adverse effect on the lower reaches of Poorman Creek. Heavy infestations of spotted knapweed, Canada thistle, and musk thistle occupy mined areas. The lowermost portion of Poorman Creek is a relatively coarse grained, moderately entrenched single thread channel.

Arrastra Creek is the western most tributary of the Blackfoot River within the Blackfoot Headwaters Planning Area. Riparian communities typically consist of black cottonwood, alder, snowberry, dogwood, and occasional spruce and willow. High width-to-depth ratios, coarse substrate, intermittent flow conditions, and local aggradations collectively suggest that the channel is overly wide due to high sediment loads. Infrequent woody debris jams create local pool and cover habitat. Livestock grazing and logging may be contributing to channel widening and increased sediment loads.

1.2 Water Quality Impairments and 303(d) List Status

The Montana 303(d) list includes several streams in the Blackfoot Headwaters Planning Area (Table 1-5). Inclusion of a stream on this list indicates that it is not supporting one or more of its beneficial uses. According to the Administrative Rules of Montana, waters in this basin are B1 streams, which designate the following beneficial uses:

- Support and propagation of cold-water fisheries,
- Associated aquatic life,
- Contact recreation,
- Agriculture,
- Industry, and
- Drinking water.

The Montana 2002 303(d) List (DEQ, 2002a) is the most current EPA-approved list. Some listings identified on the 1996 list were omitted from the 2002 303(d) list for one of two reasons.

In some cases, sufficient, credible data (SCD) were not available to assess reliably the status of a body of water with respect to certain pollutants. Alternatively, review of SCD occasionally indicated that the stream is not impaired or threatened as previously described. When SCD are lacking, the body of water becomes a priority for reassessment. In cases where the reassessment data indicate impairment, development of TMDLs will follow. In order to explain discrepancies between the 1996 and 2002 lists, this document includes information on the 1996 list and rationale for alterations to these listings.

This document addresses several causes of impairment for streams in the Blackfoot Headwaters Planning Area. These include siltation, suspended solids, habitat alterations, bank erosion, and riparian degradation. Sediment is the pollutant that effectively encompasses most or all of these causes of impairment (EPA, 1999). The objective of sediment TMDL development is to define acceptable sediment loading, transport and/or depositional characteristics associated with human sources so that water quality and stream habitat provide full support for cold-water fish and aquatic life.

Because riparian or stream habitat alterations relate to undesirable levels of sediment within a stream, TMDL development for sediment needs to be closely linked to most impairments associated with habitat alterations. These alterations can result in greater sediment loading to streams and/or alter transport and storage of sediment. Consequently, TMDL plans that restore impaired habitat also serve to decrease excess sediment deposition and overall sediment loading within the basin.

While not included as a probable cause of impairment for streams in the Blackfoot Headwaters Planning Area, barriers to fish movement throughout the basin present another identifiable constraint to cold-water fisheries. Improperly designed or maintained culverts at road crossings are the most common features that block fish migrations in forested watersheds. These fish passage barriers constitute an alteration to habitat that potentially prevents a stream from supporting propagation of cold-water fish, a designated beneficial use. This is an important consideration in the upper Blackfoot River watershed, which supports bull trout and westslope cutthroat trout. These species have migratory life history strategies and rely on headwaters for spawning and rearing. Therefore, this habitat restoration plan includes elimination of undesirable fish passage barriers as supplement to TMDL development requirements.

Dewatering is another type of habitat alteration that negatively influences fish and associated aquatic life. Most obviously, dewatering reduces the amount and quality of available habitat for fish. Dewatering may be a factor in siltation when reduced flows are not capable of transporting fine sediment resulting in accumulations on streambed surfaces. Dewatering can also negatively impact riparian health, thereby contributing to bank instability, increased sediment loading, and overall reduced habitat complexity. Furthermore, low flow volume associated with dewatering has less thermal inertia and is more susceptible to heating compared to non-altered flows. This is an important consideration in the watershed, which supports bull trout, a species very sensitive to thermal loading. The lower portion of Poorman Creek provides an example of a dewatered reach in the Blackfoot Headwaters Planning Area.

In addition to sediment, metals contamination is a cause of impairment for several streams in the Blackfoot Headwaters Planning Area. TMDL planning to reduce metals pollution occurred separately from this effort (Hydrometrics et al., 2003). However, it is important to note that restoration efforts designed to decrease loading of metals will also decrease sediment loading from mining impacted reaches. Conversely, efforts defined by this plan to reduce erosion can also reduce metals loading to streams in situations where native soils are naturally high in some metals concentrations.

1.3 Modifications and Updates to the 303(d) List

Comprehensive review of available data during the course of TMDL planning efforts indicated that several modifications to the 303(d) list were in order. Modifications include delisting of streams (as in the case of Marcum Creek), changes in impaired sub-reaches, and elimination or addition of some probable causes of impairment. This section provides a description and justification for existing or pending modifications to the 303(d) list.

1.3.1 Marcum Creek

Several lines of evidence support the removal of Marcum Creek from the 303(d) list. During two separate field investigations, both Pipp and Roberts (DEQ, 2004) were unable to locate a stream channel, observing only a jeep trail. Furthermore, sample station locations for data used in listing Marcum Creek do not correspond to an existing channel. Based on this information, DEQ determined Marcum Creek does not exist in the Blackfoot Headwaters Planning Area and removed it from the 303(d) list in 2002.

1.3.2 Willow Creek

The modification to the Willow Creek listing involved listing the entire length of this stream as impaired. This is consistent with the DEQ SCD/BUD files, which treat Willow Creek all as one stream segment. The 2002 303(d) list identifies the section of Willow Creek from Sandbar Creek to the mouth as impaired due to bank erosion. However, this is not consistent with bank erosion data and the DEQ files (DEQ, 2004), which confirm that there are impairments above Sandbar Creek.

1.3.3 Blackfoot River from the Headwaters to Landers Fork

An important concern in this TMDL planning effort was the discrepancy between the 1996 and 2002 lists for two probable causes of impairment: nutrients and other organics. Detailed analysis of existing information supports the removal or clarification of these pollutants as probable causes of impairment. The following subsections detail the rationale and justification developed by DEQ for eliminating some pollutants of concern on the 303(d) list.

Nutrients

DEQ reviewed analyses of nutrient concentrations and sources of nutrient enrichment in evaluating the potential for eutrophication in the main stem Blackfoot River. Biologically

available forms of nitrogen (nitrate + nitrite, ammonia, and ammonium) were consistently low and usually below detection limits. In contrast, total Kjeldahl nitrogen measured in 1994 was higher than average concentrations reported for the ecoregion (Richards and Miller, 2000) and occasionally higher than the value set as a standard on the Clark Fork River (0.3 mg/L). Concentrations of different forms of phosphorus were variable. Orthophosphorus, a soluble form of phosphorus was usually below the detection limit (0.01 mg/L). Concentrations of total phosphorus, a measure of all the phosphorus in the sample, were frequently higher than the ecoregion average and standards developed for the Clark Fork River. However, because total phosphorus showed a strong, positive correlation with flow, it is likely that loading of inorganic, phosphorus-bearing sediments was responsible (Confluence and DTM, 2002). Note that phosphorus adsorbed to soil particles is typically not biologically available and does not present a significant risk for eutrophication.

Potential human sources of nutrient enrichment in this portion of the Blackfoot River are limited. However, wetland marshes in the upper reaches of the Blackfoot River provide a natural source of potential nutrient loading. This possible natural source of nutrients, along with an apparent lack of negative influences to beneficial uses justify removal of nutrients as a cause of impairment on the 303(d) list. Nevertheless, nutrient sampling will continue as part of monitoring activities in the Blackfoot Headwaters Planning Area. In the event that monitoring results suggest eutrophication in this portion of the Blackfoot River, development of a TMDL to address nutrient enrichment will follow.

Other Inorganics

Inorganic constituents evaluated for this portion of the Blackfoot River include a number of common ions (sulfate, chloride, and potassium). Among the major inorganic solutes, elevated sulfate concentrations were the major concern. Sulfate concentrations have been consistently high in this reach, a condition observed since the early 1970s. Elevated sulfate is probably related to old mining activities in the headwaters and is often used as an indicator of acid mine drainage. Chloride concentrations were typically below laboratory detection limits, however, occasionally chloride exceeded mean concentrations for streams in the ecoregion (Richards and Miller, 2000). Potassium concentrations were consistently low and usually around 1.0 mg/L, a pattern holding since the 1960s. Because of the links between sulfate and metals contamination, efforts to reduce loading of sulfate are effectively included in TMDL planning for metals pollution (Hydrometrics et al., 2003).

Table 1-5. List of Impaired Waters for the Blackfoot Headwaters Planning Area (1996 and 2002).

Listed Stream and Number	List	Probable Cause(s)	Probable Source(s)	Uses Not Fully Supported Due To Sediment Or Habitat Alterations
Blackfoot River (Headwaters to Landers Fork) MT76F001-010	1996	Metals, Nutrients, Other Inorganics, Siltation	Agriculture, Harvesting, Restoration, Residue Management, Mine Tailings, Resource Extraction, Subsurface Mining	Cold-Water Fishery, Aquatic Life
	2002	Metals, Habitat Alterations	Silviculture, Resource Extraction, Acid Mine Drainage, Abandoned Mining, Habitat Modification (other than hydromodification), Bank Modification/Destabilization	Cold-Water Fishery, Aquatic Life
Blackfoot River (Landers Fork to Nevada Cr) MT76F001-020	1996	Metals, Siltation, Suspended Solids	Agriculture, Natural Sources, Resource Extraction, Silviculture	Cold-Water Fishery, Aquatic Life
	2002	Other Habitat Alterations, Siltation	Agriculture, Silviculture	Cold-Water Fishery, Aquatic Life
Willow Cr MT76F002-020	1996	Metals	Resource Extraction, Subsurface Mining	NA
	2002	Bank Erosion, Habitat alteration, Siltation	Agriculture, Grazing, Habitat Modification, Bank Modification, Highway Maintenance and Runoff	Cold-Water Fishery, Aquatic Life
Poorman Cr (headwaters to mouth) MT76F002-030	1996	Metals, Habitat Alteration, Siltation	Agriculture, Canalization, Dredge Mining, Irrigated Crop Production, Logging Road Construction/ Maintenance, Natural Sources, Resource Extraction, Stream bank Modifications/ Destabilization	Cold-Water Fishery, Aquatic Life
	2002	Dewatering, Flow Alteration, Metals, Habitat Alterations, Riparian degradation, Siltation	Silviculture, Logging roads, Construction, Resource Extraction, Abandoned Mining	Cold-Water Fishery, Aquatic Life
Beartrap Cr (Mike Horse Cr to mouth) MT76F002-040	1996	Metals	Mill Tailings, Resource Extraction, Subsurface Mining	NA
	2002	Metals	Resource Extraction, Mill Tailings	NA

Table 1-5. List of Impaired Waters for the Blackfoot Headwaters Planning Area (1996 and 2002).

Listed Stream and Number	List	Probable Cause(s)	Probable Source(s)	Uses Not Fully Supported Due To Sediment Or Habitat Alterations
Sandbar Cr (from forks to mouth) MT76F002-060	1996	Metals	Resource Extraction Subsurface Mining	NA
	2002	pH, Copper, Metals, Habitat Alterations, Siltation	Resource Extraction, Acid Mine Drainage, Abandoned Mining, Highway Maintenance and Runoff	Cold-Water Fishery, Aquatic Life
Arrastra Cr (headwaters to mouth) MT76F002-070	1996	Flow Alteration, Habitat Alterations, Siltation	Agriculture, Highway/ Road/ Bridge Construction, Natural Sources, Range Land	Cold-Water Fishery, Aquatic Life
	2002	Habitat Alterations, Siltation	Agriculture, Habitat Modifications, Shoreline Modification, Highway Maintenance and Runoff	Cold-Water Fishery, Aquatic Life

1.3.4 Beartrap Creek and Mike Horse Creek Impairments

Changes to Beartrap and Mike Horse creeks include the addition of habitat alterations as probable causes of impairment. Historic mining activities and failure of the Mike Horse Mine Dam in 1975 resulted in the listing of these streams for metals contamination on the 1996 and 2002 lists. Through the course of this TMDL planning effort, sufficient evidence of habitat alterations surfaced as another probable cause of impairment. These habitat alterations relate to mining disturbances.

1.3.5 Changes to Probable Causes on 303(d) List

There were a number of minor changes made to probable causes of impairment related to sediment pollution between the 1996 and 2002 303(d) list. These changes reflect the improved understanding of conditions in these streams following review of the available data during compilation of the 2002 list. For example, the Blackfoot River had suspended sediment as a probable cause on the 1996 but not on the 2002 list. This is because the data did not indicate a clear link between concentrations of suspended sediment and impairment. In contrast, indications that siltation impaired beneficial uses were unambiguous. Overall, this alteration in probable causes is not significant as a TMDL for sediment is still required.

1.4 Applicable Water Quality Standards

All streams in Montana are assigned a stream classification that designates appropriate standards and beneficial uses (Montana Surface Water Quality Standards and Procedures: Title 17, Chapter 30, Sub-Chapter 6). Streams in the Blackfoot Headwaters Planning Area are B-1 waters (17.30.607). As stated previously, the B-1 classification standards (17.30.623[1] ARM), include the beneficial uses “drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonids, fishes, and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.”

There are two categories of standards applicable to water quality conditions in the Blackfoot Headwaters Planning Area, numeric and narrative standards. Numeric standards apply to pollutants such as metals, organic chemicals, or other toxic constituents. These standards address concentrations known to have adverse effects on aquatic life or human health. Aquatic life standards include chronic and acutely toxic levels, which relate to partial or non-support of that beneficial use respectively. Narrative standards differ from numeric standards in that they describe either the allowable condition or an allowable increase of a pollutant over “naturally occurring” rather than a specific number. In addition to the beneficial uses as discussed above and defined within 17.30.623[1], there are several additional rules within the Water Quality Standards that apply to B-1 waters such as the Blackfoot Headwaters Planning Area and its pollutant and habitat conditions of concern. These rules (Water Quality Standards: Title 17, Chapter 30, Sub-Chapter 6 of the Administrative Rules of Montana) are summarized in Table 1-6.

DEQ typically uses a reference condition to determine if narrative water quality standards are being achieved (DEQ, 2002a), and to help set TMDL targets. The term “reference condition” is

defined as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied. Waterbodies that are used to determine reference condition are not necessarily pristine. Reference condition does not reflect an effort to turn the clock back to conditions that may have existed before human settlement, but is intended to accommodate natural variations in biological communities, water chemistry, etc. due to climate, bedrock, soils, hydrology and other natural physiochemical differences. In other words, reference condition reflects a waterbody's greatest potential for water quality given existing and historic land use activities, and should reflect minimum impacts from human activities.

Comparison of conditions in a waterbody to conditions in a reference waterbody must be made during similar season and/or hydrologic conditions for both waterbodies. The primary or secondary approach may be used to determine reference conditions. The primary approach involves:

- Comparing conditions in a waterbody to baseline data from minimally impaired waterbodies that are in a nearby watershed or in the same region having similar geology, hydrology, morphology, and/or riparian habitat.
- Evaluating historical data relating to condition of the waterbody in the past.
- Comparing conditions in a waterbody to conditions in another portion of the same waterbody, such as an unimpaired segment of the same stream.

The secondary approach involves reviewing literature, seeking expert opinion, or applying quantitative modeling such as applying sediment transport models to determine how much sediment is entering a stream based on land use information, etc.

DEQ uses the primary approach for determining reference condition if adequate regional reference data are available and uses the secondary approach to estimate reference condition when regional reference data are lacking. DEQ often uses more than one approach to determine reference condition depending on the type of data availability.

Data are often collected from “least impaired” waterbodies to determine reference condition for interpreting Montana’s water quality standards and for setting TMDL targets. The term “least impaired” is applied to waterbodies that have reasonable land, soil and water conservation practices and are supporting their beneficial uses. Often these waters have human activities occurring within their watersheds. However, the water quality impacts that are caused by the human activities are controlled by conservation practices and the stream’s water quality corresponds to its potential.

In this document the term “least impaired” is applied to waters that are either at reference condition, as described above, or likely very close to reference condition. These waterbodies may be supporting their beneficial uses relative to a given pollutant of concern, but there may be some uncertainty if the waterbody is at its greatest potential. Often, the waterbody may be recovering from past impacts, and further recovery may be possible. Nevertheless, the existing data and information from these least-impaired waterbodies are used to interpret Montana’s water quality standards and develop TMDLs targets. For this reason, adaptive management is

often proposed for the collection of additional data and information in the future to refine our interpretations of the standards and adjust TMDL targets when appropriate.

Reasonable land, soil, and water conservation practices are not always accomplished by using best management practices (BMPs) (DEQ, 2002a). BMPs are land management practices that provide a degree of protection for water quality, but they may not be sufficient to achieve compliance with water quality standards and protect beneficial uses. Therefore, reasonable land, soil, and water conservation practices generally include BMPs, but additional conservation practices may be required to achieve compliance with water quality standards and restore beneficial uses.

Table 1-6. Applicable Rules for Sediment Related Pollutant and Habitat Conditions of Concern for Waters Classified as B1.

Rule(s)	Standard
17.30.623(1)	Waters classified B-1 are to be maintained suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
17.30.623(2)	No person may violate the following specific water quality standards for waters classified B-1.
17.30.623(2)(f)	No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except as permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.637(1)	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will.
17.30.637(1)(a)	Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines.
17.30.637(1)(d)	Create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.
17.30.602(17)	“Naturally occurring,” means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied.
17.30.602(21)	“Reasonable land, soil, and water conservation practices” means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

SECTION 2.0

SUMMARY OF DATA COLLECTION AND ASSESSMENT METHODOLOGIES

This section briefly describes the information used to develop the *Blackfoot Headwaters Planning Area Water Quality and Habitat Restoration Plan and TMDL for Sediment*. Types of information included review of existing information, GIS modeling, and field assessments designed to fill data gaps and provide a basis for numeric targets. See the appendices referenced below for details regarding methods and results.

2.1 Phase I Assessment

The initial step in this watershed planning endeavor was a Phase I assessment (Confluence and DTM, 2002). A significant portion of this effort involved compilation and review of existing information. Other components of the Phase I assessment included identifying links between impairments and pollutants of concern, identification of potential sources of pollution, identification of data gaps and development of a watershed characterization. Previous work by DEQ through sufficient credible data/beneficial use support (SCD/BUD) review provided a thorough list of available sources of information on the Blackfoot Headwaters Planning Area and was an invaluable resource for Phase I planning. Resources compiled through the SCD/BUD process included data sources and reports addressing physical, biological, and physicochemical assessments in the watershed.

A major product of the Phase I assessment was development of a GIS based geomorphic risk assessment (GRA) model (Confluence and DTM, 2002). This model integrated spatial data on the physical and biological characteristics of the basin to predict potential for sediment production throughout the watershed. The model allowed for identification of potential sources of sediment in the basin and provided a means to link these sources to impairment wherever possible.

Compilation and review of biological data was another significant component of the Phase I assessment. This included fisheries information and analyses of macroinvertebrate and periphyton assemblages. The macroinvertebrate and periphyton association information was particularly useful in developing TMDL endpoints. See Appendix B for a description of analyses and interpretations.

2.2 Aerial Photography Assessment

The next step in TMDL development was an assessment of aerial photos of the Blackfoot Headwaters Planning Area. The aerial photo assessment effort had several objectives. The initial objectives included to delineation of reaches based on Rosgen Level I classification (Rosgen, 1996) and identification of potentially impaired areas. This delineation provided the basis for field sampling efforts during the summer of 2002. The other objectives included assessment of riparian cover and the amount of channel migration over the period of record. See Appendix C for detailed methods of the aerial photo assessment and assessment results.

2.3 Phase II Field Assessment

The Phase I efforts and aerial photo assessments provided the framework for Phase II field assessment in August 2002. Scientists from several state and federal agencies contributed to this watershed-scale effort. The objectives of the field assessment were to fill data gaps, identify sources of sediment loading and habitat alterations, and collect data used in the development of numeric targets for TMDLs and other restoration goals. Appendix D provides more detail on the field assessment methods.

Three principal components comprised the 2002 field assessment activities. The first component was a reconnaissance inventory of conditions on 303(d) listed tributaries of the Blackfoot River. The purpose of this reconnaissance was to evaluate geomorphic and riparian conditions and other indicators of impairment in these streams. The second component of the field assessment consisted of a bank erosion inventory and geomorphic assessment of the Blackfoot River. The bank erosion inventory provided information on the proportion of banks that are eroding, severity of bank erosion, and the grain size contributed from those banks. A proximity-weighted index of human influence applied to each eroding bank provided a means to evaluate the relative roles of human activities and natural disturbance on increasing erosion.

The final component of the field assessment was an evaluation of physical habitat using a combination of two common habitat assessment methodologies: Environmental Monitoring and Assessment Program (EMAP) habitat methods developed by the EPA (Lazorchak et al., 1999) and the R1/R4 fish habitat inventory developed by the US Forest Service (Overton et al., 1997). Because EMAP methods comprised the majority of this assessment approach, “modified EMAP” is an appropriate description of this methodology. Reaches were located in areas identified in the aerial photo assessment as representing either typical or potentially impaired reaches of the Blackfoot River and listed tributaries. In addition, evaluation of a number of least impaired or reference reaches provided a means to develop numeric endpoints. The modified EMAP allowed for assessment of a number of parameters including percent surface fines, riparian structure and composition, bank full dimensions, volume of woody debris, and a proximity-weighted index of human influence.

Synthesis of reconnaissance, erosion inventory, EMAP habitat assessments, and aerial photo analysis provided the basis to describe the fluvial geomorphic processes for sub-reaches of the Blackfoot River and its listed tributaries. This assessment includes other identified impairments and conditions that merit attention such as barriers to fish migration and noxious weed infestation. See Appendix E for detailed geomorphic descriptions of the Blackfoot River and listed tributaries.

2.4 Sediment Load Estimations from Eroding Banks

The erosion inventory conducted as part of field assessments in 2002 provided the basis for estimating the amount of sediment contributed from bank erosion in the main stem of the Blackfoot River (Appendix F). A number of analyses supported this method of estimating loads. The first step involved determination of an average rate of bank retreat for the Blackfoot River.

Comparison of rates of bank retreat from aerial photos of the Blackfoot River with rates observed in similar streams provided an annual average retreat for banks on the Blackfoot River. The next step was to calculate volumes of sediment from the surveyed banks on the Blackfoot River. Field data collected on length, height, and severity of erosion for each eroding bank and soil data addressing bulk density of the soils were used in this calculation. These analyses culminated in an estimate of the average, annual load of sediment from eroding banks for each sub-reach of the Blackfoot River. Finally, incorporation of a proximity-weighted human influence index measured for each eroding bank allowed for inference on the load contributed due to human activities along the stream margin as well as the relative contributions from the different types of human activities.

2.5 McNeil Core Analyses

A wealth of McNeil Core data provided by the US Forest Service presented an opportunity to develop TMDL targets based on potential for spawning success. Over the course of 15 years, the USFS collected McNeil cores at numerous sampling stations throughout the basin. Note that McNeil core sampling is the most accurate method of sampling substrate composition in comparison to other commonly used methods (Young et al., 1991). Sources used in development of criteria for suitability of spawning gravels included scientific literature (primarily Kondolf, 2000), the potential for the stream to meet the criteria, and input from TMDL specialists from DEQ. Appendix G provides detailed methods and results for these analyses.

2.6 Arrastra Creek Fish Habitat Survey

Existing assessments of physical habitat conditions in Arrastra Creek (USFS, unpublished data) provided a quantitative basis for assessing stream conditions and establishing targets. USFS field crews conducted a fish habitat assessment (Hankin and Reeves, 1988) in Arrastra Creek in 1996. These data provide a surrogate for the modified EMAP assessments conducted during Phase II field assessments in 2002. Appendix H provides a summary of the results from this analysis.

2.7 Landers Fork Investigations

The Landers Fork, a major tributary of the Blackfoot River, has a strong influence on the geomorphology and character of the Blackfoot River below its confluence. The Landers Fork produces a substantial sediment load from glacial deposits from much of its length. Still, the role of land use practices in exacerbating sediment delivery and transport was not well documented. Therefore, TMDL planning efforts included an effort to characterize conditions in the Landers Fork in order to assess the relative impacts of human activities on channel morphology, sediment production, and water yield. These activities included a field reconnaissance investigation and analysis of the Landers Fork sediment transport potential (Appendix I).

2.8 Road Sediment Analyses

The US Forest Service (Helena National Forest) and Plum Creek Timber Company conducted an analysis of sediment derived from forest roads in select areas of the watershed. From this, they developed sediment delivery rates for unit length of roads. Within the project GIS, it was

possible to extrapolate these rates to all roads within the Blackfoot Headwaters Planning Area. The result was an estimate of sediment contributed from roads in sub-watersheds throughout the Blackfoot Headwaters Planning Area. Appendix J provides details on road sediment data, analysis, and results.

2.9 Poorman Creek Road Investigations

During the mid-1990s, the USFS conducted investigations on roads in the Poorman Creek watershed as part of an environmental impact statement (EIS) investigation for watershed-wide vegetation management. Several of these investigations had similar objectives to these TMDL planning efforts. These include estimation of volume of sediment contributed from roads, identification of barriers to fish movement, identification of undersized culverts, and remedies to reduce sediment loading to streams. Appendix K provides a summary of these investigations in Poorman Creek.

2.10 Road Traction Sanding

Sanding roads to increase traction during winter months provides a potential source of increased sediment loading to streams in the Blackfoot Headwaters Planning Area, specifically the main stem of the Blackfoot River and Willow Creek. An analysis provided the basis to estimate loading of sand to these streams (Appendix L). This analysis was based on the length of highway within a certain distance from each stream, sand application rates, and estimated delivery of road sand to the stream.

2.11 Assessment of Upland Sources of Sediment to Streams

Production and delivery of sediment from upland sources is a natural occurrence in watersheds. Still, many human activities can intensify these processes resulting in increased siltation over background levels. Enhancement of the GIS-based Sediment Source and Delivery Model (SSDM) developed in Phase I allowed estimation of potential sediment production and delivery potential from upland sources. The model was used to delineate areas within the watershed that are more prone to both produce sediment and deliver sediment to tributary and main stem streams. The sediment production component of the model integrates spatial information on slope, soil erodibility, vegetative cover, and precipitation. Sediment delivery is a function of the connectivity of high sediment production areas via steep, low vegetation cover areas to streams. In order to summarize the resultant data by a meaningful management unit, the watershed was subdivided into 16 sub-watersheds, each representing the contributing area of a significant stream in the basin. Figure 9 shows the location of the sub-watersheds and identified areas of elevated sediment production and delivery potential. Table 3-1 in the next section summarizes the results by sub-watershed. Appendix M provides an explanation of the SSDM Model and results.

This model has several applications with regard to water quality planning in the Blackfoot Headwaters Planning Area. First, it provides a tool to quantify relative loading of upland sediment from human activities among sub-watershed in the larger basin. Second, it provides a tool to help develop restoration goals and to help with implementation planning. The

identification of high-risk areas with steep slopes, low vegetation cover, higher precipitation, erodible soils, and connectivity to streams provides the Blackfoot Challenge and Blackfoot River communities with a tool to manage land use activities to avoid excess sediment loading following land disturbances.

SECTION 3.0

EXISTING STREAM CONDITIONS RELATED TO SEDIMENT AND HABITAT IMPAIRMENT

This section addresses existing stream conditions, sources of sediment and related habitat impairment in the Blackfoot Headwaters Planning Area. The focus is on nonpoint sources of pollution and the links with riparian condition and stream morphology, as there are no known point sources of sediment pollution in the Blackfoot Headwaters Planning Area. Data assessment methods summarized in Section 2.0 and detailed in appendices provide the basis for these descriptions.

Sediment production and transport is a natural occurrence within watersheds. A significant challenge in this TMDL development was to partition the natural, background loads from human-induced loads and to then determine to what extent the loads associated with human activities can be controlled via BMPs and reasonable land, soil and water conservation practices. This is an important distinction in light of Montana's water quality standards and the use of reference conditions. To explain, some of the narrative standards are based on increases above "naturally occurring" concentrations of sediment that can negatively impact beneficial uses. The multiple lines of evidence to assess sources and potential for delivery of sediment (summarized in Section 2.0 and detailed in the appendices) provide the basis for discriminating among natural and human-related sources.

There are several potential natural sources of sediment in the upper Blackfoot River watershed. Erosion and ultimate delivery of sediment from hillslopes is a potentially significant natural source, especially in areas with erodible soils and low vegetation cover. Mass wasting is an extreme form of hillslope erosion that can contribute large amounts of sediment to streams. Note that review of aerial photos and satellite images did not locate any significant examples of mass wasting in this portion of the Blackfoot River watershed. Finally, some erosion of stream banks is a natural occurrence within streams that contributes to the system's sediment load.

Human activities can accelerate natural erosional processes resulting in contributions of sediment in excess of natural, background levels. Examples of human activities that increase sediment production and delivery include removal of riparian vegetation, such as may be caused by land clearing or grazing. Land use practices that reduce riparian vegetation can increase the rate and change the pattern of bank erosion. Channel changes, such as historic channel straightening or activities that prevent natural channel movements, also cause accelerated erosion. Removal or alterations in vegetative cover on uplands have the potential to increase hillslope erosion above natural. Similarly, increased water yield from vegetation removal can accelerate bank erosion downstream through increases in peak flows. Erosion from the surface of roads is another potential source of sediment from streams. This also includes sediment contributed from cut and fill slopes along roads, sanding, and impacts associated with culverts and bridges. Finally, significant reductions in flow during lower flow periods may influence sediment by reducing transport resulting in increased amounts of fine sediment settling on the streambed.

An additional goal of assessment efforts is to evaluate overall human influences on stream stability. A “stable” stream is one that has the ability, over time (in the present climate), to transport the flows and sediment produced by its watershed in such a manner that the dimension, pattern and profile are maintained without either aggrading, or degrading (Rosgen, 1996). Accelerated erosion can cause changes in stream channel stability and associated stream type changes. The instability and consequential shifts in stream type can further increase sediment supply, cause reduced land productivity, land loss, fish habitat degradation, and degrade the physical and biological function of rivers.

3.1 Blackfoot River Conditions (Above Landers Fork)

The field assessment in 2002 combined with existing sources of information provided a robust means to describe existing riparian and channel conditions in the Blackfoot River. In addition, this assessment allowed for identification of sources of sediment and calculation of loads from various sources. Based on these analyses, it was possible to verify or negate impairment status and differentiate among natural and human-induced sources of sediment or channel instability.

3.1.1 Biological Indicators

Periphyton and aquatic macroinvertebrate assemblages are commonly assessed indicators of biological integrity and represent a direct measure of the level of support of aquatic life, a designated beneficial use. For the Blackfoot River above the confluence with the Landers Fork, metals contamination appears to be an overwhelming influence on biotic communities (Appendix B). This includes high proportions of abnormal diatoms (Bahls, 2001), an indication of toxics, and severely depressed mayfly, stonefly, and caddis fly richness and abundance (Bollman, 2001). Because metals contamination may mask or overwhelm community response to siltation, the ability to draw inferences regarding siltation from these data is limited.

3.1.2 Physical Habitat

Field assessments of 2002 combined with analyses of aerial imagery provided the primary means of evaluating the physical habitat in the Blackfoot River above the confluence with Landers Fork. In general, sediment and habitat conditions in this reach appear to be “least impaired” and provide a suitable reference for developing TMDL targets. The exception to this is a reach in the uppermost portions of the stream affected by mining activities. Otherwise, the channel is predominately stable with erosion balanced by storage. Siltation was minimal as described by several indicators including surface fines measured with the 49-point grid (Appendix E) and McNeil cores (Appendix G).

3.1.3 Sediment Source Loading Determinations

A number of sources of sediment have the potential to increase loading of fine sediment to this portion of Blackfoot River and its tributaries. These include eroding banks, roads, road traction sanding, and hillslope erosion. The following subsections summarize the estimated contributions of sediment from these sources.

Estimate of Sediment Load from Stream Bank Erosion

The erosion inventory conducted in 2002 provided the basis to characterize bank erosion in this reach and estimate a yearly load of sediment from eroding banks (Appendix F). Overall, bank erosion was not a significant feature in this portion of the Blackfoot River. Geomorphic analyses indicate a mostly stable stream channel with erosion balanced by local storage of sediment (see Appendix E). Most eroding banks rated as slightly eroding with relatively few banks in the moderate or severe categories. In addition, the human influence indexes calculated for eroding bank indicate minimal human disturbance. Human activities leading to accelerated erosion include roads, revetments, and limited grazing. Overall, the results suggest that most bank erosion was the result of natural patterns of erosion and aggradation and not significantly intensified by human activities. In terms of sediment load, bank erosion in this portion of the Blackfoot River produces the lowest estimated volume of sediment per mile of any reach in the Blackfoot River examined in this planning effort (Figure F-2). Therefore, bank erosion is not a significant contributor of sediment to the Blackfoot River above the Landers Fork.

Sediment from Road Surface Erosion

Increased sediment delivery to streams from roads is a probable source of impairment in the Blackfoot Headwaters Planning Area. The results of two separate analyses by the USFS and Plum Creek Timber Company provided information to quantify these increased sediment loads. The USFS approach involved developing a road sediment delivery coefficient for a unit length of road surface based on field measurements. In contrast, the Plum Creek approach involved detailed measurements at road/stream crossings of road surface, cut slope, and fill slope areas as well as observations on soil type, traffic level and other factors affecting sediment routing from the roads. Both methodologies yielded similar results for sediment yield per unit length of road. Since the Plum Creek Timber Co. method sediment yield per unit length (0.26 tons/mile) was slightly higher than the USFS estimate, this coefficient was then applied to all roads in the planning area to develop total sediment yield from roads. Although these analyses were conducted on forest roads, the sediment production coefficient was applied to all roads in the planning area regardless of surface. The rationale used is that even though roads with gravel or paved surfaces will yield less sediment than forest roads per unit area, these roads have a larger footprint and therefore a larger cut slope and fill slope. This will lead to a similar sediment yield per unit length of road. The results from this analysis for all of the Blackfoot Headwaters are presented in Appendix J. These results do not indicate high levels of loading to the Blackfoot River, with a total of about 7 tons of sediment loading to this reach via results for the upper Blackfoot and the 303(d) listed Willow Creek combined (Table J-1).

Sediment from Highway Traction Sanding

Road sanding in winter months is a potential source of sediment to this portion of the Blackfoot River. Efforts to evaluate sediment loading from road traction sanding are described in Appendix L. Essentially, this analysis suggests that the road sand load in the upper portion of the watershed is similar to the above load from forest roads.

Hillslope Erosion and Increased Water Yield

The sediment source and delivery model (SSDM) described in Appendix M provides a means to evaluate the relative potential of sub-watersheds to produce and deliver sediment from hillslope erosion. Sediment loads for the Blackfoot River above the confluence with the Landers Fork are sourced from two of the sub-watersheds in Table 3-1; upper Blackfoot and Willow Creek listed. Approximately 11 to 12% of the area in these two sub-watersheds has a relatively high potential to both produce and deliver sediment to streams based on model results (Columns F and G). None of this higher sediment production and delivery potential area is known to have had recent (1992-1999) timber harvests (Column G). The modeled increase in water yield due to vegetation reduction over this same time was also negligible in the Willow Creek listed and very low in the Upper Blackfoot (Column H). Based on this analysis, hillslope erosion is not believed to be a significant source of sediment to the watershed. Also, the analysis indicates that increased sediment production associated with increased water yield and peak flows is not a significant concern.

Table 3-1. Results of SSDM Model. Area of Recent Vegetation Changes, Predicted Elevated Sediment Source and Delivery Potential, and Predicted Water Yield Increase from Recent Vegetation Changes are Listed.

Column A	Column B	Column C	Column D	Column E	Column F	Column G	Column H
Sub-watershed Name	Area (acres)	Percent High Cover (1999)	Percent High Cover Change, 1992 to 1999	Percent of Area with Elevated Potential Sediment Yield and High Cover (1999)	Percent of Area with Elevated Potential Sediment Yield and Low Cover (1999)	Percent of Area with Elevated Potential Sediment Yield and Recent Harvest	Calculated % Change in Water Yield, 1992 to 1999
Arrastra Creek	15218	66.8	-1.9	16.9	3.9	0.5	1.2
Beaver Creek	11509	75.6	-1.3	6.9	2.7	0.0	0.8
Copper Creek	26663	83.2	-0.6	9.0	4.2	0.0	NA
Humbug Creek Area	16720	76.2	-3.3	2.9	0.4	0.0	1.0
Keep Cool Creek	9103	77.4	-5.5	1.5	0.1	0.0	1.6
Landers Fork	83722	73.4	-1.4	4.9	1.5	0.0	1.3
Lincoln Gulch	7628	79.9	-3.5	9.3	0.8	0.2	1.0
Mineral Hill	1464	28.6	0.0	0.4	2.5	0.0	0.3
Moose Creek Area	7497	84.1	-9.0	3.6	0.9	0.4	3.0
Patterson Prairie	6524	54.6	-5.0	7.2	4.5	1.2	1.4
Poorman Creek	26294	90.7	-1.4	15.5	0.8	0.0	0.6
Sauerkraut Creek	9150	74.6	-18.5	0.6	0.1	0.0	5.9
Stonewall Creek	17349	73.4	-1.3	12.8	1.8	0.0	0.4

Table 3-1. Results of SSDM Model. Area of Recent Vegetation Changes, Predicted Elevated Sediment Source and Delivery Potential, and Predicted Water Yield Increase from Recent Vegetation Changes are Listed.

Column A	Column B	Column C	Column D	Column E	Column F	Column G	Column H
Sub-watershed Name	Area (acres)	Percent High Cover (1999)	Percent High Cover Change, 1992 to 1999	Percent of Area with Elevated Potential Sediment Yield and High Cover (1999)	Percent of Area with Elevated Potential Sediment Yield and Low Cover (1999)	Percent of Area with Elevated Potential Sediment Yield and Recent Harvest	Calculated % Change in Water Yield, 1992 to 1999
Upper Blackfoot	73786	79.8	-1.1	9.8	1.5	0.0	0.5
Willow Creek	11854	77.5	-5.3	0.3	0.0	0.0	1.7
Willow Creek listed	12381	88.2	0.0	11.6	1.5	0.0	0.1

3.2 Blackfoot River (Landers Fork to Nevada Creek)

A significant amount of information was available to evaluate the existing conditions in this reach of the Blackfoot River. A substantial portion included monitoring data collected by state and federal agencies. In addition, the field assessment of 2002 focused considerable effort on this portion of the Blackfoot River. Finally, evaluations in the Landers Fork (Appendix I) were an important component of evaluating the relative roles of human activities and natural disturbance on the geomorphic character and water quality conditions in the Blackfoot River below the confluence with the Landers Fork.

3.2.1 Biological Indicators

Macroinvertebrate and periphyton samples collected in this reach of the Blackfoot River suggest conditions ranging from minor (not impaired per the 303 (d) list) to moderate (impaired per the 303[d] list) impairment of aquatic life beneficial uses (Appendix B). Indications from diatom associations suggest the continued impact of metals contamination at sampling sites in the reach of the Blackfoot River, although these indicators diminished with distance from the source of metals in the headwaters.

Macroinvertebrate communities collected on the Blackfoot River demonstrated indications of both siltation and drought conditions. Samples collected in 2001 suggested moderate impairment at the sampling station near Helmville Bridge with depressed richness of clinger taxa. In contrast, macroinvertebrate community composition at the station just above Nevada Creek did not demonstrate indications of impairment. Still, macroinvertebrate monitoring at this location in the late 1980s and the early 1970s suggest siltation impaired beneficial uses (McGuire, 1991).

3.2.2 Physical Habitat

Fluvial geomorphology, bank and riparian condition, and substrate composition change dramatically along this portion of the Blackfoot River. In the section of river between the Landers Fork and Lincoln, conditions are mostly the result of substantial deposition of coarse bedload from the Landers Fork. This results in a wide, braided channel characterized by bedload storage. While residential development poses isolated alterations in habitat conditions, these are minimal compared to the overwhelming influence of sediment inputs from the Landers Fork.

While this portion of the Blackfoot River does not provide quality habitat for fish, the question regarding causality was important from a restoration and TMDL perspective. In other words, were the observed habitat conditions the result of natural disturbance or were human activities negatively influencing conditions in the Landers Fork and ultimately the Blackfoot River. Investigations in the Landers Fork associated with this planning effort suggested that while human activities had a minor impact on the Landers Fork, natural factors were the overwhelming influence (Appendix I).

Conditions change dramatically below Lincoln, Montana. The channel returns to a single thread channel, bank erosion becomes more prevalent, and substrate composition becomes progressively finer. Furthermore, sediment core data collected in this reach indicate accumulations of fine sediment on the streambed are at levels that are harmful to cold-water fisheries (Appendix G). These fines are at levels shown to limit survival of salmonid embryos and provide evidence of sediment impairment in the Blackfoot River.

Additional evidence of impairment in this reach of the Blackfoot River includes the relatively large percentage of eroding banks linked to human influences (Appendix F; Table F-3) and the corresponding relationship between bank erosion and human influence (Figure F-3). This suggests that streamside management activities are decreasing the health and function of banks and increasing rates of bank erosion.

3.2.3 Sediment Source Loading Determinations

Estimate of Sediment Load from Stream Bank Erosion

Bank erosion is a significant feature in this portion of the Blackfoot River. In the assessment of 2002, observers inventoried eroding banks in 32% of this reach and documented about 10 miles of eroding bank (Appendix F). When extrapolated along the total length of the Blackfoot River from Nevada Creek to the headwaters, this yielded an estimated loading of 34,492 tons of sediment per year that comes from eroding banks along this stream.

To evaluate compliance with water quality standards, it is important to distinguish between natural and human sources of sediment. Human influence index information suggested a strong correlation between bank erosion severity and human disturbance. Still, a considerable proportion of eroding banks lacked obvious indications of human activities influencing bank stability. Furthermore, not all sediment contributed from banks associated with human disturbance can be attributed to human activities. Using best professional judgment, an estimate

of 75% of the erosion from banks associated with human disturbance was linked to the human disturbance. This yields an estimate of 5,250 tons per year from human activities. Livestock grazing was the most significant influence (about 50% of the total human influence index), followed by encroachment by roads and railroads (25% of total). Buildings, logging, and revetments all had relative contributions between 5 and 10% of the total impacts from human activities (Appendix F, Table F-3).

Sediment Contributed from Roads

Increased sediment delivery to streams from roads was evaluated as a source of loading. The total road sediment load throughout the drainage was estimated at about 302 tons per year (Appendix J). Most or all of this load has the potential to reach the lower segments of the Blackfoot River above Nevada Creek.

Sediment from Highway Traction Sanding

Evaluation of potential delivery of sand from traction sanding (Appendix L) suggests this mechanism could deliver a total of about 12 tons per year of sediment to the Blackfoot River. This sand comes from Highway 200, which is located within 200 feet of the Blackfoot River for over three miles of its length in the Blackfoot Headwaters Planning Areas, and located within 200 feet of Willow Creek for about 0.6 mile.

Hillslope Erosion and Increased Water Yield

Hillslope erosion and a related increase in water yield is a probable source of sediment loading to the Blackfoot River. Table 3-1 above lists the results of the SSDM model used to predict which areas have elevated potential to both produce and deliver sediment to streams. All 16 of the tabled sub-watersheds are tributaries to the Blackfoot River and/or include main stem portions of the Blackfoot River drainage from the headwaters to Nevada Creek. Therefore, all of the tabled areas can be considered sources of sediment to this reach. Note the total percent area with an elevated potential to produce and deliver sediment (Columns E + F) varies from a high of 20.8% in Arrastra Creek to a low of 0.3 % in Willow Creek (unlisted). Other drainages with high sediment potential include Copper Creek (13.2%), Patterson Prairie (11.7%), Poorman Creek (16.3%), Stonewall Creek (14.6%), Willow Creek listed (13.1%).

The total amount of apparent timber harvest in these drainages between 1992 and 1999 provides an indication of the potential for increased hillslope erosion (Column D). Harvest during this period has been as high as 18.5% of Sauerkraut Creek drainage to 0% in Willow Creek listed. Many of the drainages have harvest levels during this period of less than 2%. Other drainages with significant recent harvest during this period include Keep Cool Creek (5.5%), Moose Creek (9.0%), Patterson Prairie (5.0%), and Willow Creek (5.3%). Equally important is how much of the total drainage includes harvest within the areas of elevated potential sediment production and delivery. This varies from 1.2 % in Patterson Prairie to 0% for the majority of the watershed. This analysis suggests that hillslope erosion is not a significant source of sediment to the watershed if timber harvest involved a high rate of BMP compliance, particularly in the areas of elevated potential sediment production.

The total harvest within the drainage was also used to calculate water yield (Column H) as an indicator of potential increased impacts to channel bank erosion (see Appendix M for discussion on methodology). The calculated increases for the 1992 to 1999 period ranged from as high as 5.9% in Sauerkraut Creek to nearly 0% in Willow Creek listed. All other drainages had values less than 2%, with the exception of Moose Creek Area with a 3% calculated water yield increase. This indicates a potential for increased bank erosion in a few tributaries due to increased flow conditions, with any increased sediment production likely reaching the lower reaches of the Blackfoot River. Most tributaries appear to have had only minor increases and increased erosion from water yield in these tributaries is considered insignificant. The exception may be the Landers Fork, where minor increases in water yield can lead to significant increases in bank erosion as identified in Appendix M. This analysis indicates that increased sediment production associated with increased water yield and peak flows is probably not a significant concern.

3.3 Arrastra Creek Assessment Results

3.3.1 Biological Indicators

Macroinvertebrate and periphyton associations gave mixed results with regard to siltation in Arrastra Creek (Appendix B). The siltation index calculated from diatom associations at the two sampling stations in Arrastra Creek was consistent with full support and excellent biological integrity. Based on metric results, macroinvertebrate communities indicated an impairment at the upper site and full support at the lower site. Additionally, richness of clinger taxa was relatively low at both sampling sites, which provides evidence that siltation may be negatively affecting aquatic life beneficial uses on Arrastra Creek, although there was a low sample size (total organisms collected) at the upper site thus reducing the reliability of the data (Bollman 2001).

3.3.2 Physical Habitat

Investigations used in assessing the physical habitat in Arrastra Creek include reconnaissance investigations conducted in August 2002 (Appendix E) McNeil core samples collected by USFS personnel (Appendix G) and a fish habitat survey conducted by USFS personnel in 1996 (Appendix H). Habitat conditions observed in Arrastra Creek consistent with sediment impairment include an overly wide, aggradational channel with a large supply of cobble-sized particles (see Appendix H for geomorphic descriptions). Undersized culverts may be contributing to braided, depositional areas from obstructed flows upstream of culverts thereby further limiting habitat suitability for fish locally.

Analyses of substrate composition suggest relatively low levels of fine sediment in the upper reaches on the stream and increasing siltation in the lowest reach. Pebble counts conducted as part of the 1996 fish habitat survey indicate particles less than 2.38 mm in diameter account for nearly 35% of the substrate. Although based on a different methodology, these levels are still significantly greater than levels measured in the Blackfoot River above the Landers Fork, a reach that appears to be an acceptable reference or least-impaired condition for tributary streams in the Blackfoot Headwaters Planning Area. Furthermore, McNeil core data provide evidence of excess siltation with proportions of fine sediment at levels that impair propagation of salmonids.

3.3.3 Sediment Source Loading Determinations

Estimate of Sediment Load from Stream Bank Erosion

Data to support estimation of sediment loads contributed from eroding banks as described in Appendix F were not collected on Arrastra Creek. Still, there are indications that human activities are accelerating bank erosion above natural on Arrastra Creek. Specifically, fish habitat assessments collected by USFS personnel indicates about 40% of stream banks in the lowest reach of Arrastra Creek are vegetated but unstable, a condition that may increase sediment loading from bank erosion to Arrastra Creek (Appendix H).

Estimate of Sediment Loads from Roads

Roads in the Arrastra Creek watershed are a potential source of sediment loading. There are over 73 miles of road in the Arrastra Creek drainage that yield an estimated 19 tons per year of sediment to surface waters (Appendix J). Note that Arrastra Creek has one of the higher road densities in the planning area, leading to a relatively high proportion of sediment loading from roads.

Hillslope Erosion and Increased Water Yield

Results of the model developed to assess the potential for hillslope erosion (Appendix M) suggests that the Arrastra Creek sub-basin contains the largest proportion of area falling into the category of elevated sediment production and delivery potential (Table 3-1, Columns E and F). While it is not possible to provide a defensible estimate of a numeric load from hillslope erosion, these results suggest that Arrastra Creek has a higher potential to produce and deliver relatively high levels of sediment from both natural and human induced hillslope erosion compared to other sub-watersheds in the Blackfoot Headwaters Planning Area. Although the Arrastra Creek watershed has undergone only a moderate level of recent timber harvest at 1.9% of the total drainage (Column C), a fair amount of harvest has been in the areas of elevated sediment risk (0.5% per Column G). Also of concern would be potential impacts from excessive grazing pressure in the areas of elevated sediment potential, although this activity was not evaluated outside of riparian zones. Based on this analysis, hillslope erosion could be a significant source of sediment to the watershed if timber harvest and other activities in areas of elevated potential sediment production have not involved a high rate of BMP compliance. The relatively low water yield increase (1.2%) due to timber harvest indicates that increased sediment production associated with increased water yield and peak flows is probably not a significant concern in this watershed.

3.4 Poorman Creek Assessment Results

3.4.1 Biological Indicators

Biological indicators on Poorman Creek suggest moderate to no impairment from siltation at the three sampling stations (Appendix B). The siltation index developed for diatom associations was

slightly elevated at the middle sampling station, a level consistent with minor impairment but full support of beneficial uses. The full range of macroinvertebrate community metrics calculated in Table B-3 indicates full support at all three sites. In contrast, the clinger taxa results at the upper and lower sampling stations on Poorman Creek indicate a potential impairment based on richness of clinger taxa at these stations.

3.4.2 Physical Habitat

A combination of long term monitoring and more recent field evaluations conducted in August 2002 provide evidence of several types of impairment of physical habitat in Poorman Creek. These relate to sediment pollution in that they are direct measures of sediment in the system or relate to the links between stream morphology and riparian function and sediment pollution. Another observed limitation to support of cold-water fisheries was the presence of several potential barriers to fish migration in the basin.

Assessments of substrate composition provide evidence for siltation impairing beneficial uses in Poorman Creek. Long term monitoring of substrate composition using McNeil cores indicates relatively high levels of particles less than 6.35 mm in spawning areas (Appendix G). These levels were considerably higher than levels occurring in the main stem of the Blackfoot River above Landers Fork, an internal reference for tributaries in the Blackfoot Headwaters Planning Area. Similarly, fines measured with the 49-point grid during field assessments in August 2002 were markedly higher than the upper Blackfoot River reference conditions (see Appendix E).

Placer mining in the lower reaches in Poorman Creek has resulted in alterations to stream morphology that changed sediment transport processes and limited habitat for fish (see Appendix E). These reaches are overly wide, aggraded reaches that lack pool development. In some areas, the stream has cut through spoil piles. Although these areas are currently stable, fish habitat limitations support an impairment determination.

Of considerable concern in Poorman Creek is the occurrence of several undersized or perched culverts (see Appendix E and K). These present several potential problems in Poorman Creek. For example, undersized culverts are at risk of washing out during high flows, thereby increasing channel instability and contributing sediment to the stream. In addition, some culverts present possible barriers to fish movement in the basin, which are a constraint to a stream's ability to support cold-water fisheries, a key beneficial use. On the other hand, fish barriers in streams with westslope cutthroat trout, are sometimes desirable to prevent encroachment of brook trout. This emphasizes the importance of incorporating fisheries management plans into TMDL and water quality planning efforts to ensure implementation plans are consistent with native fish conservation objectives.

3.4.3 Sediment Source Loading Determinations

Estimate of Sediment Loads from Roads

Roads in the Poorman Creek basin have the potential to increase sediment loading to surface waters. Poorman Creek has over 85 miles of road and a road density of 2.08 miles of road per

square mile. Two analyses provided estimates of sediment contributed from roads in the Poorman Creek basin. First, a watershed wide evaluation based on road/sediment relations by USFS and Plum Creek modeled an estimate of loading from all roads in the Poorman Creek basin (Appendix J). In addition, the USFS conducted an intensive survey of several roads in the basin that identified sources of sediment loading, poorly designed road crossings, and barriers to fish (Appendix K).

USFS and Plum Creek based calculations of sediment contributed from roads throughout the Poorman Creek basin indicate these roads supply about 22 tons of sediment per year to surface waters. The road density in the Poorman Creek watershed is considerably lower than Arrastra and Willow creeks as well as many other drainages in the Blackfoot Headwaters Planning Area. As a result, Poorman Creek has less potential to contribute sediment per watershed area than these streams, based on the analysis used in Appendix J. Nevertheless, the existence of a major, unpaved road along substantial portions of the main stem of Poorman Creek presents an additional risk for sediment loading.

Estimates of sediment contributed by roads conducted by the USFS indicate that the surveyed roads contribute over seven tons per year of sediment to Poorman Creek and its tributaries. Note that this survey focused primarily on roads on USFS property and used a different methodology than the road erosion survey discussed above. The USFS investigations included numerous recommendations to decrease risks of sediment loading. Moreover, the USFS has completed a significant portion of these improvements.

Hillslope Erosion and Increased Water Yield

The Poorman Creek sub-watershed contains a relatively high percent total area (16.3%) with elevated potential to produce and deliver sediment (Table 3-1, Columns E and F). While it is not possible to provide a defensible estimate of a numeric load from hillslope erosion, these results suggest that Poorman Creek has a high potential to produce and deliver sediment from both natural and human induced hillslope erosion compared to other sub-watersheds in the Blackfoot Headwaters Planning Area. Human related activities of concern include timber harvest and grazing. Poorman Creek watershed has undergone only a moderate level of recent timber harvest at 1.4% of the total drainage (Column C), and no harvest was in areas of elevated sediment potential (Column G), indicating a relatively low overall increased risk of significant sediment production from hillslope erosion. Also, the total recent harvest only had a minor calculated increase (0.6%) in water yield (Column H), also indicating a low risk of increased sediment production.

3.5 Willow Creek Assessment Results

3.5.1 Biological Indicators

Biological indicators of siltation are equivocal from the sampling stations on Willow Creek. The siltation index calculated from diatom associations at the upper site shows some negative impact but is consistent with minor impairment and full support. The lower site scored higher within the

range of full support. In contrast, richness of clinger taxa calculated from macroinvertebrate community composition scored with the range of full support.

3.5.2 Physical Habitat

Assessments of physical habitat suggest that highway encroachment is a cause of limited habitat alterations on Willow Creek. This includes localized gully erosion and channelization. In addition, both McNeil core data and percent fines measured with the 49-point grid suggest that siltation is elevated above natural levels. Furthermore, DEQ field assessment notes from 2001 indicate that bank erosion constitutes a probable indicator of impairment in the reach above the Sandbar Creek confluence. This reach has experienced severe down cutting in addition to the bank erosion, and land use indicators suggest historic grazing as a probable source that led to these conditions. Current grazing practices no longer appear to be a significant limiting factor for recovery of this reach, whereas upstream floodplain constriction from a Forest Service bridge is possibly limiting stream recovery in this impaired reach.

3.5.3 Sediment Source Loading Determinations

Estimate of Sediment Load from Stream Bank Erosion

Data to support estimation of sediment load from bank erosion were not available. Still, a field assessment conducted by DEQ indicates that bank erosion and related habitat alterations associated with a down cutting impair beneficial uses. The alterations increase sediment loading to the stream and, more importantly, severely reduce habitat suitability for fish and likely contribute to intermittent flow conditions.

Estimate of Sediment Loads from Roads

Roads in the Willow Creek basin have the potential to increase sediment loading to surface waters. There are nearly 60 miles of road in this watershed yielding a relatively high road density of 3.06 miles of road per square mile of area. Modeling results (Appendix J indicate roads in the Willow Creek drainage contribute an estimated 15 tons of sediment to surface waters per year.

Hillslope Erosion and Increased Water Yield

The Willow Creek (listed) sub-watershed contains a relatively high percent total area (13.1%) with elevated potential to produce and deliver sediment (Table 3-1, Columns E and F). No recent harvest activity has occurred in these sensitive areas (Column G). While it is not possible to provide a defensible estimate of a numeric load from hillslope erosion, these results suggest that Willow Creek has a high potential to produce and deliver sediment from both natural and human related hillslope erosion compared to other sub-watersheds in the Blackfoot Headwaters Planning Area. Human related activities of concern include timber harvest and grazing, although water quality impacts from timber harvest in the form of hillslope erosion or increased water yield appear to be negligible for the 1992 through 1999 period evaluated.

Road Traction Sanding

Road traction sanding by MDOT is another potential source of sediment loading to Willow Creek. Highway 279, which parallels Willow Creek for nearly its entire length before it crosses the Blackfoot River, encroaches within 100 feet of streams for 0.15 miles and within 200 feet for 0.60 miles. Using methods to estimate delivery of sand described in Appendix L, an estimated 3.3 tons per year of road sand is potentially delivered to Willow Creek on an annual basis.

3.6 Sandbar Creek Assessment Results

3.6.1 Biological Indicators

Metals contamination in Sandbar Creek presents a confounding factor in evaluating siltation based on the periphyton and macroinvertebrate communities. Metals contamination in this stream contributed to ratings of severe impairment of beneficial uses. However, biological indications of siltation were not readily apparent. Still, because of the overwhelming influence of metals on these communities, it is difficult to assess reliably the impacts of siltation based on these analyses.

3.6.2 Physical Habitat

Reconnaissance investigations documented several types of alterations to physical habitat in Sandbar Creek (see Appendix E). Mining activities had substantial negative influences on physical habitat in the upper reaches of this stream. Mine tailings border the banks in the upper reaches and iron hydroxide covers much of the stream substrate. Presence of these metals contaminated sediments constitute a metals-related impairment, linked to siltation of metals precipitates, that differs from the typical, uncontaminated sediment listing for most other streams in the Blackfoot Headwaters Planning Area. Remediation, related to TMDL development for metals, should also require mechanical restoration of the stream channel in upper impacted reaches. Near its mouth, the Highway 279 embankment channelizes approximately 200 ft of Sandbar Creek providing another negative impact on in-stream habitat. Bank failure, flow impoundment, and loss of cross section definition characterize this channel segment.

3.7 Beartrap Creek & Mike Horse Creek

Failure of the Mike Horse Tailings Dam in the 1976 and other historic mining activities have contributed to major alterations in physical habitat in Mike Horse Creek and Beartrap Creek. The restoration goal is to incorporate habitat restoration as a required element of remediation efforts associated with metals remediation (Hydrometrics et al., 2003). This plan addresses the development of targets and restoration objectives to supplement the remediation goals associated with mining impacts to these streams.

SECTION 4.0

IMPAIRMENT STATUS OF STREAMS IN THE BLACKFOOT HEADWATERS PLANNING AREA

This section summarizes sediment and habitat related impairment status for 303(d) listed streams in the Blackfoot Headwaters Planning Area. Information utilized in these descriptions includes assessments and analyses summarized in Section 3.0. See the appendices for detailed descriptions of these methods and results.

An important consideration in determining impairment status is the water quality standards that apply to the pollutants of concern. This planning effort focused on sediment and associated habitat alterations, which are addressed with narrative standards as opposed to numeric standards. The challenge in applying narrative standards is determining the extent to which the observed conditions deviate from naturally occurring conditions and determining if this deviation is harmful to aquatic life or other beneficial uses.

A number of criteria and evaluations provided the basis to evaluate the extent to which conditions depart from naturally occurring or a least-impaired condition in the Blackfoot Headwaters Planning Area. These are described in more detail in the appendices. For measures of substrate composition, an internal reference and regional comparison provided the means to evaluate departure from desirable or least-impaired conditions. Analyses of McNeil core data collected from tributary streams located in or near the Blackfoot Headwaters Planning Area formed the basis of evaluating which sampling sites where impairment from excess fine sediment (siltation) was likely (Appendix G). Likewise, comparison of percent fines measured with a 49-point grid to an internal reference was a way to evaluate the extent to which siltation differed from a least-impaired condition.

Biological indicators also afforded an approach to evaluate impairment status and support of beneficial uses. Montana Department of Environmental Quality has developed biological indicators for benthic macroinvertebrates and periphyton (Bahls, 1993; Bollman, 1998) that evaluate biological integrity, a measure of beneficial use support. These integrate a number of community level responses to various environmental stressors into an overall score or rating. To evaluate sediment pollution in the Blackfoot Headwaters Planning Area, metrics that measure the response to siltation received more emphasis. These include the siltation index developed for diatom associations and richness of clinger taxa, a metric under development for application in Montana streams (Wease Bollman, personal communication).

Measures of physical habitat conditions such as riparian vegetation structural composition, bank condition, and channel morphology are other concerns in evaluating impairment status with regard to sediment. Departure from reference was evaluated using a combination of different reference approaches combined with evaluations of associated human disturbance. This allowed evaluation of whether observed conditions were natural or related to land use activities.

4.1 Blackfoot River: Headwaters to Landers Fork

Detailed review of the various investigations on the Blackfoot River above Landers Fork to the upper marsh area indicates this reach is not impaired for sediment or habitat-related conditions. As a result, a TMDL for sediment or restoration targets to address sediment or habitat impairment is not necessary for this section of the Blackfoot River. Although a TMDL is not required for this segment of the Blackfoot River, there are a number of opportunities for conservation. Restoration in this portion of the watershed is still necessary to maintain existing habitat conditions and to support water quality goals for downstream reaches of the Blackfoot River. Therefore, Section 6.0 details a management strategy aimed at conserving or improving existing full support conditions.

Several lines of evidence were available to evaluate the impact of sediment and related habitat conditions on beneficial uses in this reach of the Blackfoot River. These include macroinvertebrate and periphyton associations, pebble counts, McNeil cores, bank erosion inventory, and a habitat assessment. Biological indicators were consistent with impairment from metals, but not for sediment or habitat alterations. Indications that sediment or habitat alterations do not impair beneficial uses include relatively low surface fines as measured by several methods, limited eroding banks, and low human influence index associated with eroding banks. Geomorphic indicators suggest that this reach is in balance in terms of sediment production and storage. Evaluations of riparian condition provide evidence that human activities have minimal negative influences on riparian health and function. Large woody debris numbers, which can be an important contribution to fish habitat and indicator of beneficial use support, tend to be low over much of this reach. This appears to be due dominance of large marsh complexes and steep hillsides in this reach. These are features with limited potential for contributing woody debris.

While habitat conditions in most of this portion of the Blackfoot River are consistent with full support of beneficial uses, it is important to note an isolated area of habitat alteration in this stream. Failure of the Mike Horse Tailings Dam in 1976 contributed nearly 100,000 tons of tailings to two tributary streams and ultimately the Blackfoot River. This failure, along with other mining related impacts, resulted in severe impairment of habitat in about one mile the Blackfoot River. This reach extends from the upstream extent of the Blackfoot River, the confluence of Beartrap and Anaconda Creeks, to the upstream end of the upper marsh area. For water quality planning purposes, this reach is impaired due to habitat alterations. This impairment results in partial support of two beneficial uses, cold-water fish, and aquatic life.

In summary, this reach of the Blackfoot River will remain listed as impaired due to habitat alterations as identified on the 2002 303(d) list. However, it is important to note that this impairment covers a relatively short portion of the reach. Accordingly, this plan includes restoration goals to address the habitat alteration impairments. Although the habitat alterations could be linked to sediment storage and/or transport problems, such relationships are difficult to define and provide limited advantage to the development of appropriate restoration goals in this situation. These restoration goals include targets and a defined methodology on how to achieve the targets, thereby effectively addressing the major components of a sediment TMDL.

4.2 Blackfoot River: Landers Fork to Nevada Creek

Both natural factors and human activities influence conditions in this reach of the Blackfoot River. For example, natural disturbance and large volumes of bedload result in a braided, overly wide channel in the Blackfoot River between Landers Fork and Lincoln. While changes in management may result in small gains in habitat and water quality conditions, overwhelming natural conditions are the limiting factors in this section.

In contrast, human activities do result in significant impairment of water quality and habitat in the reach below Lincoln to Nevada Creek. The resulting degradation of physical habitat and water quality constitute impairment, thus requiring development of a TMDL to reduce fine sediment pollution and associated impacts to physical habitat. The beneficial uses affected by sediment pollution and associated habitat alterations are cold-water fish and associated aquatic life.

Examinations of available biological and physical data confirm this determination. The primary indication of impairment associated with fine sediment are McNeil core samples collected by Helena National Forest personnel from several locations in this reach from the late 1980s to the present. Substrate composition shows a marked increase in fine sediment compared to samples collected upstream of this reach. Furthermore, this increase in fine sediment, when compared to reference conditions, was at levels that would be harmful to incubating eggs and would contribute to increased entombment of fry. Bank erosion data demonstrate that contributions of fine sediment from banks are at least partly associated with human disturbance, therefore indicating that the elevated percent fines are preventable via best management practices and reasonable land, soil, and water conservation practices. Furthermore, eroding bank lines do not provide high quality habitat for fish. These reaches are typically devoid of undercut banks and overhead cover, important components of fish habitat.

In-channel sources of sediment such as bank erosion are not the only contributor to this portion of the Blackfoot River. Sediment contributed from roads and upland sources exceed background levels. Surveys of roads and culverts identified numerous cases where sediment delivery occurred from poorly designed roads and/or improperly applied BMPs in the basin. Recent timber harvest and associated road building activities in tributary watersheds have increased the risk of production and delivery of fine sediment to the Blackfoot River. In many parts of the watershed, the increased sediment loading associated with timber harvest may be within naturally occurring levels if BMPs are being applied appropriately. In a few small drainages, timber harvest has been substantial, thereby increasing the risk of sediment production above naturally occurring levels. Observations by local biologists of highly turbid flows from recently logged drainages corroborate modeled predictions of increased hillslope erosion and delivery.

In summary, this reach of the Blackfoot River will remain listed as impaired due to siltation and habitat alterations as identified on the 2002 303(d) list. Biological and physical data support the determination that human activities increase sediment loading to streams and result in degraded physical habitat in this reach. The sediment TMDL presented in this plan will address both of these impairments to help return the river to conditions that fully support its beneficial uses.

4.3 Arrastra Creek

Assessment results indicate that sediment and related habitat impacts are causes of impairment in Arrastra Creek. Sediment loading has created impairments through two mechanisms: aggradation and excess fine sediment. Aggrading conditions, as described in Appendix H, limit desirable habitat for aquatic life due to undesirable channel characteristics. Accumulations of fine sediment on streambed surfaces negatively affect both cold-water fisheries and aquatic life beneficial uses. McNeil sediment cores collected in the lower reaches of Arrastra Creek downstream of the Forest Service boundary, exceeded target criteria for particles < 6.35 mm and < 2.38 mm in some of the recent sample events. Macroinvertebrate communities indicated impairment at the lower site. In addition, clinger taxa richness, a metric sensitive to siltation, was less than 14 at the lower site where an adequate numbers of invertebrates were present in the sample allowing this analysis. Richness of clinger taxa of less than 14 is a numeric target developed for evaluating the effects of siltation on aquatic life (Appendix B). This evidence suggests that Arrastra Creek is partially supporting cold-water fisheries and aquatic life beneficial uses, at least in the lower assessed portions.

There are several probable sources of sediment loading and habitat alterations in the Arrastra Creek watershed. These include activities related to timber harvest that increase hillslope erosion, erosion from forest roads, and livestock grazing. Increased water yield from timber harvest and disruption of riparian areas from grazing can lead to channel widening and a resultant decrease in sediment transport capability. It is important to note that Arrastra Creek has a naturally high potential to produce and deliver sediment due to the presence of erodible areas with low vegetative cover in proximity of streams, and is therefore more susceptible to human induced increases in sediment loading.

In summary, Arrastra Creek will remain listed as impaired due to siltation and habitat alterations as identified on the 2002 303(d) list. Both physical and biological evidence support this listing. The sediment TMDL presented in this plan will address both of these conditions to help return the river to conditions that fully support its beneficial uses.

4.4 Poorman Creek

Assessment results show that Poorman Creek is impaired due to sediment and related habitat alterations. The majority of the evidence pointing to impairment was physical in nature. These included high proportions of fine sediment in cores (Appendix G), habitat alterations due to placer mining, riparian degradation, and eroding banks. This results in proportions of fine sediment that limit survival-to-emergence of salmonids. Similarly, these conditions present a limitation to aquatic life by limiting habitat suitability. In addition, clinger taxa richness, a metric sensitive to siltation, was less than 14 at one of three sites, thus indicating impairment due to fine sediment.

A number of land use activities negatively influence water and habitat quality in Poorman Creek. Livestock grazing, placer mining and residential development were identifiable sources of impairment in the lower reaches of Poorman Creek. Roads were another probable source of

sediment loading and channel alterations. Poorly designed culverts, road crossings, and other erosive features associated with roadways were present at numerous locations in the basin.

Several culverts present another probable limitation to fisheries potential in the Poorman Creek watershed. Perched or otherwise improperly designed culverts at road crossing are common habitat alterations that have the potential to restrict fish movements through the Poorman Creek watershed. In some cases, these can present a condition that prevents a stream from supporting propagation of salmonids. For example, westslope cutthroat trout and bull trout spawn in headwater streams, which they may not be able to access due to impassable culverts.

Dewatering in the lower stretches of Poorman Creek is another potential contributor to an increase in-streambed siltation. Low flow volumes due to irrigation withdrawals may decrease stream energy to the point that fine sediment accumulates on the streambed. These low flows also negatively impact the riparian health, which then has negative impacts on bank and channel stability. In addition, the flow diversions and resulting lack of flow during portions of the year create a separate impairment. Although TMDL development is not a requirement to address this impairment associated with low flows, increasing flows to help flush fine sediments and improve riparian health can be part of the solution to excess fines. Water users in the Poorman Creek sub-basin have been working cooperatively with the Department of Natural Resources Conservation to maintain in-stream flows.

In summary, this reach of Poorman Creek will remain listed as impaired due to siltation and habitat alterations consistent with the 2002 303(d) list. The riparian degradation impairment cause may be removed due to redundancy with the other two causes. The development of a TMDL for sediment and the development of additional habitat restoration goals will address these impairments from a beneficial use support perspective. Dewatering and flow alteration, both of which address the same issue on the lower stretch of Poorman Creek, will also remain on the 303(d) list as a cause of impairment. This plan includes restoration goals to address the flow related impairment.

4.5 Willow Creek

Assessment results indicate that Willow Creek is impaired due to sediment and related habitat conditions. Evidence supporting this determination includes both biological and physical indicators. Biological indicators include elevated periphyton siltation index and partial support rating for macroinvertebrates at the upper sample location. Physical indicators include elevated fines measured with a 49-point surface fine grid. Channel alterations probably associated with historic grazing practices are also contributing to eroding banks and associated habitat degradation.

Links between human activities and observed conditions strengthen impairment determinations on Willow Creek. Roads and probable historic grazing practices were recognizable disturbances that influenced physical habitat and water quality. This relationship between human activities and water quality and habitat conditions substantiates the impairment determination for this stream.

In summary, this reach of Willow Creek will remain listed as impaired due to siltation and habitat alterations consistent with the 2002 303(d) list. The bank erosion cause of impairment may be removed due to redundancy with the other two causes. The development of a TMDL for sediment and the development of additional habitat restoration goals will address these impairments from a beneficial use support perspective.

4.6 Sandbar Creek

Review of existing information indicates impairment of habitat in Sandbar Creek resulting in partial support of salmonid fishes and associated aquatic life. Significant habitat alterations occur in two reaches. Highway 279 channelizes about 200 feet of channel upstream of where it crosses Sandbar Creek. Further upstream, historic mining and related road building has disrupted the geomorphology of this reach. These habitat alterations constitute an impairment of cold-water fisheries and aquatic life beneficial uses due to the resulting lack of pools, woody debris, and riparian vegetation. Metals contamination presents another significant impairment of beneficial uses in Sandbar Creek. Precipitates of metals blanketing much of the streambed in Sandbar Creek provide an obvious indication of metals pollution. This impairment is addressed in TMDL development for metals contamination, which is part of a separate planning effort for the Blackfoot Headwaters Planning Area (Hydrometrics et al., 2003).

In summary, Sandbar Creek will remain listed as impaired due to siltation and habitat alterations. The siltation listing is addressed in the metals TMDL due to the links with metals pollutant (Hydrometrics et al., 2003). This plan includes restoration goals to address the habitat alterations impairment. Although the habitat alterations could be linked to sediment storage and/or transport problems, such relationships are difficult to define and provide limited advantage to the development of appropriate restoration goals in this situation. These restoration goals include targets and a defined methodology on how to achieve the targets, thereby effectively addressing the major components of a sediment TMDL.

4.7 Beartrap and Mike Horse Creeks

Assessment results show that Beartrap Creek & Mike Horse Creek are both impaired due to habitat alterations. Past mining activities, including failure of the Mike Horse Tailings Dam, have significantly altered physical habitat conditions in these streams. Impairment indicators include limited pools, woody debris, and riparian vegetation. These alterations result in impairment of cold-water fish and aquatic life beneficial uses. Habitat alteration listings will be added as impairment causes for both streams, with Mike Horse Creek being an addition to the 303(d) list. This plan includes restoration goals to address these impairments. Similar to Sandbar Creek and the upper section of the Blackfoot River, these goals effectively address all the major components of a sediment TMDL.

SECTION 5.0

WATER QUALITY GOALS

This section presents water quality goals to address causes of sediment and habitat impairment for each waterbody that will remain on the 303(d) list due to causes other than metals. The goals include water quality targets, total maximum daily loads (TMDLs) and allocations. The water quality targets are numeric or measurable values that represent desired conditions and achievement of water quality standards, both numeric and narrative, for each stream. TMDLs are developed where sediment impairment exists. The TMDL identifies the maximum sediment loading, sediment reductions, and/or other conditions necessary to achieve target values. The TMDL is allocated among the various sources. These allocations apply to existing sources that contribute to sediment and related habitat impairments. Allocations can also be developed for future activities that have the potential to significantly contribute to impairment if not properly managed (EPA, 1999). Together, the water quality goals provide a basis for prioritizing efforts and measuring success of improvement activities in the Blackfoot Headwaters Planning Area. Section 6.0 provides a practical implementation strategy to achieve the goals defined in this section.

Adaptive management is applied toward the water quality goals defined within this section. Adaptive management addresses important considerations such as feasibility and uncertainty in establishment of targets, TMDLs and allocations. For example, despite implementation of all restoration activities, the attainment of targets may not be feasible due to any number of reasons. Natural disturbance such as forest fires, flood events, or landslides may negate the effects of restoration activities for a period of time, therefore extending the period before target conditions can be satisfied. Similarly, it is possible that the natural potential of some streams will preclude achievement of some targets. For instance, natural geologic and other conditions may contribute fine sediment at levels that prevent the attainment of numeric targets associated with fine sediment. Conversely, some targets or allocations may be underestimates of the potential of a given stream and more stringent targets may be more appropriate. In light of these issues, it is important to recognize that the adaptive management approach provides the flexibility to refine allocations, targets, and restoration activities to ensure compliance with Montana's water quality standards. Section 7.0 provides further discussion on adaptive management.

5.1 Blackfoot River (Landers Fork to Nevada Creek)

5.1.1 Targets

Water quality targets for this reach of the Blackfoot River include both biological targets and substrate composition targets (Table 5-1). These targets are all applicable to the sediment impairment and any sediment-related habitat impairment. All targets must be met to satisfy applicable water quality standards and ensure full support relative to the sediment impairment. The target for periphyton associations requires that samples meet biological indicators for full support developed for Montana mountain and foothill valleys streams (Bahls, 1993). Targets for macroinvertebrates require that communities meet criteria for full support of beneficial uses based on criteria developed by Bollman (1998). Both the periphyton and macroinvertebrate

targets only apply to conditions that can be linked to sediment and/or habitat alterations. For example, it is possible to have an impairment associated with periphyton communities that is linked to metals, but the sediment and habitat indicators imply full support and thus satisfy the sediment TMDL target. Furthermore, the target for clinger taxa richness is a value greater than or equal to 14 based on DEQ's standard protocol for data collection and analysis (DEQ, 2002b). Most recent performance on these assessments indicates that both macroinvertebrates (based on clinger taxa richness) and periphyton assemblages suggest a variety of conditions. These range from sediment impairment to full support of beneficial uses in the Blackfoot River between Landers Fork and Nevada Creek (Appendix B). Table 5-1 summarizes these results. Note that deviations from target conditions due to sediment impacts are relatively minor.

Future research efforts may result in refinement or changes to biological indicators and metrics. Therefore, DEQ may update the biological indicators and metrics used for beneficial support determinations as TMDL and related target development continues throughout the state. These updated biological indicators, under the direction of DEQ, may replace one or more of the biological targets within Table 5-1.

Substrate composition targets developed for the Blackfoot River include fine sediment in two gradations (< 2.38 mm, and < 6.35 mm). These target conditions are to be applied to all three sub-reaches (Dalton, Helmville, Nevada/Odgen). Table 5-1 provides a summary of these targets based on least-impaired reference conditions developed in Appendix G. Table 5-1 also provides existing percent fines results for the Blackfoot River (from Appendix G) and the departure from the target conditions. Note that the existing conditions are further from meeting the finer 2.38 size gradation target than the coarser 6.35 mm gradation target. The data indicate that reductions as high as 38% from existing levels of fines < 2.38 mm may be necessary to meet the target based on 1997 results for the Nevada-Ogden Reach. The other two sites are closer to meeting target conditions, and the 2000 results for the Dalton Reach show that target conditions are met for both percent fines targets.

Section 8.0 summarizes and addresses sampling requirements for assessing target compliance. Macroinvertebrate and periphyton sampling is to be done at three representative locations similar to the McNeil Core sampling target requirements. This sampling should be coordinated with similar biota sampling required to assess metals targets (Hydrometrics et al., 2003). Percent fines sampling in the three sub-reaches will continue to be at the same areas previously sampled with specific locations representing documented spawning sites. To meet the target conditions, the 2.38 mm and 6.35 mm median values for a set of five or more core samples per location need to satisfy the target value. Average values may be an acceptable alternative to median values in the event that available assessment data is limited, assuming that such an approach can be properly justified.

When evaluating target compliance, comparisons should be made to reference condition data from the same representative period, meaning that reference stream monitoring will need to continue and target values could change due to climate or other conditions. As discussed in Section 1.4 and Appendix G, the least impaired streams used to determine reference condition may under-represent the stream's potential. For example, the Blackfoot River between the Landers Fork and the upper marsh is the only reference or least impaired stream where full

support of beneficial uses relative to sediment impacts has been documented through adequate assessments. Therefore, these percent fines targets may be updated using a subset of the five least impaired streams or by incorporating information from new reference or least impaired streams.

The targets all apply under normal conditions of natural background loading and natural disturbance. It is recognized that under some natural conditions such as a large fire or flood events, it may be impossible to satisfy some of the targets, such as percent fines, until the stream recovers. The goal, under these conditions, will be to ensure that management activities within the watershed or individual tributaries are undertaken in such a way that the achievement of targets is not significantly delayed compared to natural recovery. Another goal will be that human activities do not significantly increase the extent of negative water quality or habitat impacts from natural events during the recovery period.

Another important factor is target achievability. The reference condition approach implies that 25% of streams may naturally vary above the target value since it is set at the 75th percentile of the reference range. Also, the lower portion of the Blackfoot River is unique in comparison to most of the tributaries, and has high natural fines loading from eroding banks and from the Landers Fork. This natural loading could preclude meeting one or more target conditions even after successful implementation of management practices. The adaptive management approach discussed in Section 7.0 accounts for these uncertainties.

Table 5-1. Water Quality Targets for the Blackfoot River (Landers Fork to Nevada Creek), Existing Conditions, and Departure from Target.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Macroinvertebrate and periphyton assemblages will score as full support of beneficial uses for sediment and habitat related indicators	Periphyton data indicate full support Macroinvertebrate data indicate impairment at one of two recently sampled locations	Target currently satisfied. Target not satisfied; metals impacts may mask ability to interpret relative sediment impacts.
Clinger taxa richness will be ≥ 14	Clinger taxa richness at two locations range from 13 to 15	One location satisfies target, another location needs a small increase in taxa richness from 13 to 14 to meet target.
The median of percent fines < 2.38 mm in McNeil core samples will be $\leq 15\%$	Medians values range from 13 to 24%	Conditions range from satisfying the target to requiring a significant reduction (24% value needs to decrease to 15% or less); reduction needed to meet the target may be less based on recent sample results.

Table 5-1. Water Quality Targets for the Blackfoot River (Landers Fork to Nevada Creek), Existing Conditions, and Departure from Target.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
The median of percent fines < 6.35 mm in McNeil core samples will be \leq 29%	Median values range from 20% to 34%	Ranges from satisfying the target to requiring a reduction from 34% to 29% fines; reductions needed to meet the target may be less based on recent sample results.

5.1.2 Total Daily Maximum Load (TMDL)

The technical definition of TMDL is “the sum of load allocations plus waste load allocations plus a factor of safety.” Alternatively, the TMDL can be expressed through appropriate measures other than mass loads per time (40 CFR 130.2). The use of an alternative approach for sediment TMDL analysis is justified in guidance developed by EPA (EPA, 1999). EPA guidance recognizes that it can be difficult or impossible to relate sediment mass loading levels to use impacts or source contributions. The analytical connections can be difficult to draw for several reasons including the following:

- sediment yields vary radically at different spatial and temporal scales within a watershed making it difficult to draw meaningful “average” sediment conditions;
- sediments are a natural part of all waterbody environments making it difficult to determine whether too much or too little mass loading is expected to occur in the future and how sediment loads compare to natural or background conditions; and
- a significant level of uncertainty is associated with sediment delivery, storage, and transport estimates.

A commonly used alternative approach is to express the sediment TMDL as a percent reduction in loading. This reduction can be based on departure from target conditions or estimates of human loading conditions above natural background loading. Table 5-1 suggests that a reduction in the < 2.38 mm fine sediment load as high as 38% could be required to meet all target conditions, although recent 2000 core sample results suggest a lower sediment loading reduction to meet targets, perhaps in the 10 to 15% range.

Appendix F Blackfoot River bank erosion study results attribute 5,200 tons of the total 34,500 tons to controllable human activities, or about 15% of the total (5,200 divided by 34,500). In comparison to other human related loads in the watershed, this bank erosion loading appears to be the most significant load that can be addressed via management practices. The proximity of this loading to the impairment conditions contributes to the significance of this load. Sediment delivery from roads and highway sanding were also identified as quantified loads that can be reduced via management practices. Based on the estimated bank loading reduction that can be achieved via management practices and the likely reduction necessary to meet target conditions, the sediment TMDL for the Blackfoot River between Landers Fork and Nevada Creek is expressed as a 15% reduction in sediment delivery. This reduction will come from decreasing

bank erosion along the Blackfoot River from Nevada Creek to the headwaters and from roads and highways throughout the watershed.

5.1.3 Allocations and Land Use Indicators

Allocations are developed for significant sources or source categories as necessary to achieve the targets identified in Section 5.1.1. Per EPA guidance (EPA, 1999), sediment TMDLs should clearly provide for allocations by source based on maximum allowable loads, needed load reductions, or, in some cases, source control actions. This section provides allocations for the identified sources of sediment impairment.

Also included are land use indicators that address sources not covered by the allocations. These sources are currently not considered significant to the point where reductions are necessary to meet TMDL and target conditions. Nevertheless, these additional sources or source categories should be tracked to ensure that they do not become significant problems and to ensure protection of water quality in the watershed.

5.1.3.1 Allocations

The allocations for the Blackfoot River sediment TMDL are presented in Table 5-2. Because the differing methodologies used in the source assessment analysis (Section 2.0) can lead to varied sediment loading results, the allocations approach used here applies load reductions or control actions to several of the key source categories as an added margin of safety to ensure protection of the resource. The allocations all apply to three categories of nonpoint sources that include accelerated stream bank erosion from human impacts along the Blackfoot River, sediment delivery from roads, and road sanding. There is also a waste load allocation to address point sources covered by storm water permitting. The allocations are consistent with the TMDL in Section 5.1.2 and should result in conditions where sediment targets in Section 5.1.1 are satisfied.

Table 5-2. Allocations for Identified Sources of Sediment to the Blackfoot River (Landers Fork to Nevada Creek).

Sediment Source Category	Load or Waste Load Allocations
Accelerated stream bank erosion from human impacts along the Blackfoot River (Nevada Creek to headwaters)	15% reduction in total yearly sediment load from eroding banks along the Blackfoot River.
Sediment Delivery from Roads	30% reduction of sediment loading from all roads in the watershed.
Road Traction Sanding	Based on development and implementation of road sanding BMPs (performance-based allocation).
Storm Water Permits	Based on proper implementation and maintenance of erosion BMPs consistent with standard storm water permit conditions (performance-based allocation).

The “accelerated stream bank erosion” allocation will apply to the human activities that can be addressed via BMPs. In Appendix F, it was estimated that about 75% (5,200 tons) of the maximum bank erosion due to human activities was controllable via management practices. The 5200 tons represents 15% of the total 34,500 tons of yearly load from eroding banks. Thus justifying the 15% allocated load reduction. About 50% of the total maximum human related bank erosion is attributed to cattle grazing, which may represent the most controllable portion of the sediment loading from accelerated bank erosion. Roads, revetments, lawns, and logging are other human activities associated with eroding banks. Some of these activities are linked to permanent infrastructure such as roads or buildings. Under these circumstances, some of the bank erosion impacts may be irreversible, which is why the allocation only applies to a percentage of the total loading associated with human activities. Nevertheless, all significant sources should be evaluated to promote implementation of management practices that will eliminate or minimize erosion where possible. The use of riprap or other stream hardening techniques will not be considered acceptable erosion reducing approaches for meeting sediment reduction allocations, and can be considered a contribution toward increased bank erosion. In addition, future growth along the Blackfoot River would need to be managed in a way that is consistent with this allocation to ensure full support of beneficial uses.

The “sediment delivery from roads” allocation applies to timber harvest activities as well as county and other private roads. The 30% reduction is based on Forest Service and Plum Creek analyses on roads under their control after full BMP implementation. Other landowners can be expected to have similar capabilities for sediment loading reductions via BMP applications. This equates to a 90 ton per year modeled reduction in potential loading to the tributaries and the Blackfoot River based on the results presented in Appendix J. This is double the load reduction that would be achieved if set at the 15% TMDL load reduction value. The 30% reduction is used in recognition of achievable reductions from this source category and as a component of the margin of safety. The use of a 30% reduction is also important for the protection of tributary streams to avoid impairments in these streams. This road sediment allocation can be applied to individual landowners. For example, the Forest Service will have satisfied this allocation, as it relates to them, if they have reduced sediment inputs by 30% for roads under their management.

The performance-based road sanding allocation is based on ongoing efforts by the Montana Department of Transportation to incorporate BMPs. This includes ongoing research to identify the best designs and procedures for minimizing road sand impacts to adjacent waterbodies. These BMPs must also be compatible with the safety of the traveling public and road maintenance crews. Road sand BMPs may include a reduction in plowing speeds, improved maintenance and road sand recovery, and the increased use of chemical deicers as long as doing so does not create a safety hazard or cause undue degradation to plant and water quality. Implementation of BMPs should be focused on those stretches of highway within 200 feet, with significant focus on those stretches within 100 feet of the river or tributary stream. It is anticipated that the BMPs, once implemented, will ultimately lead to a percent reduction of road sand loading consistent with the sediment TMDL.

The waste load allocation for storm water permits is based on proper implementation and maintenance of erosion BMPs consistent with standard storm water permit conditions. These permits typically require erosion controls versus setting discharge loads. At this time there is at

least one point source of sediment permitted under the National Pollutant Discharge Elimination System. This point source is addressed via a storm water permit for the Upper Blackfoot Mining Complex. The erosion controls include application and maintenance of BMPs. Similar storm water permits are possible to address mining or other future developments within the watershed. This performance-based allocation will apply to all such permits.

TMDL development to address causes of impairment in listed waters downstream from the confluence of the Blackfoot River and Nevada Creek could require sediment and other pollutant loading reductions in the Blackfoot Headwaters. It is expected that the sediment allocations described above will be consistent with future sediment and nutrient TMDL development in downstream waters. This integration of planning across the larger basin is part of a watershed approach to planning and restoration.

5.1.3.2 Land Use Indicators

As discussed above there are additional sources or source categories that should also be tracked to ensure protection of water quality in the watershed. These sources are currently not considered significant sources of loading and therefore do not require load reductions to meet TMDL and target conditions, but could become significant sources if BMPs and/or reasonable land, soil, and water conservation practices are not applied. These sources include timber harvest impacts associated with hillslope erosion, timber harvest impacts associated with flow alterations that can contribute to in-stream bank erosion or stream scour, and impacts from road crossings with undersized or poorly maintained culverts. For each of these source categories, indicators are developed to help determine conditions where significant sediment loading may be possible. These indicators do not represent allocations, but do represent conditions where future allocations could be required or where additional study may be necessary to ensure that water quality is adequately protected.

5.1.3.2.1 Timber Harvest Impacts on Hillslope Erosion

In timber harvest areas, hillslope erosion and sediment delivery to streams is typically not observed when forestry BMPs are applied to logging skid trails and Streamside Management Zones (SMZs) are retained as required by State Law (Ethridge and Heffernan, 2001). However, harvest and other alterations in riparian vegetation near streams not covered under the SMZ law can present a higher risk of sediment delivery. A land use indicator is therefore developed to address this sediment delivery concern.

The assessment of potential sediment contributions from upland sources (Appendix M) identified areas of elevated potential sediment yield for each tributary watershed. The results of this analysis revealed that most watersheds only had minor amounts of recent timber harvest within these areas (Column G of Table M-1). A few small watersheds had harvest levels approaching or exceeding 10% of the total of this higher risk sediment yield area (Column G divided by Column E). The analyses generally identified an area as going from high to low cover when harvest occurred, and then returning back to high cover after vegetation had been established, which would typically occur within 7 years. This amount of recent harvest in areas of high sediment potential should therefore be used as an indicator to help ensure that hillslope erosion from

timber harvest is not a significant source of sediment loading to the Blackfoot River and individual tributary streams. Whenever the amount of recent harvest exceeds or is expected to exceed 10% of the total potential high sediment production area there should be a review of BMP planning and implementation success in these high-risk areas to ensure that hillslope erosion and delivery is minimized.

5.1.3.2.2 Timber Harvest Impacts on Peak Flows

As discussed in Appendix M, timber harvest activities can affect water yield such that peak flows can be increased and lead to increased bank erosion and bed scour. In fact, the analyses for the Landers Fork in Appendix M suggests that such increases within this drainage can be significant, probably much more than other drainages due to the significant existing loading potential from this stream (Appendix I). The analysis for water yield detailed in Appendix M suggested that forestry activities resulted in generally low water yield increases between the 1992 to 1999 time frame for all tributary drainages (Column H, Table M-1). Another approach to evaluate water yield is based on equivalent clear-cut area (ECA) protocols developed by the Forest Service, where forest harvest impacts on ECA and resultant modeled water yield are sometimes kept within 10%, adjusting for channel stability and/or soil characteristics following ECA protocols (King, 1989). Therefore, the modeled water yield indicator within any impaired tributary drainage (Arrastra, Poorman, and Willow Creeks) and the Blackfoot River drainage as a whole is set at 8%. The indicator level in all other tributary drainages is set at 10% with the exception of the Landers Fork, which is set at 6% due to the significant potential loading conditions. Any time a proposed harvest will exceed any of these values, the cumulative impacts associated with potential peak flow increases should be evaluated to ensure consistency with the allocations, TMDL, and target goals developed within this document.

In evaluating potential impacts and/or determining whether this indicator level has been reached, the historic structure of conifer stands can be a consideration. In other words, some types of thinning efforts may actually end up increasing water yield, but the increase may be more representative of naturally occurring conditions. Also, areas of permanent settlement and permanent land clearing, such as the town of Lincoln, can be considered a naturally occurring ECA reduction within the watershed. Alternatively, forest roads are to be added to the ECA. For watersheds where fire has significantly increased water yield, then increases in water yield due to timber harvest are to be evaluated to ensure that management activities within the watershed or individual tributaries are undertaken in such a way that the recovery time to conditions where the targets can be met is not significantly delayed. Another goal will be that water yield increases due to human related clearing do not significantly increase the extent of negative water quality or habitat impacts from natural events during the recovery period.

The use of water yield and potential impacts on a stream is consistent with EPA guidance for sediment TMDLs (EPA, 1999), which states: “In some settings, land management changes cause changes in runoff even if they do not result in increased upslope erosion. Where this occurs, channel erosion or sediment deposition may increase. It might be appropriate to develop sediment TMDLs to address this type of situation.” Montana State Water Quality Standards also support limits on water yield and related increased flow where activities increasing mean monthly flows above a certain value can require an authorization to degrade (ARM 17.30.715).

5.1.3.2.3 Impacts from Undersized or Improperly Maintained Culverts

This planning effort did not include an analysis of the potential loading associated with undersized culverts. Analyses performed in other watersheds, such as for St Regis TMDL development (Lolo National Forest, unpublished data) indicate that the sediment loading risk associated with undersized or poorly maintained culverts could be significant within individual tributaries of the Blackfoot Headwaters Planning Area. An indicator of the potential risk is overall road density, since a higher road density indicates more stream crossings. The Forest Service classified road density in examining the characteristics of aquatic/riparian ecosystems in the Columbia River Basin. Road density was considered “high” if it exceeded 1.7 miles per square mile (USDA Forest Service, 1996). Therefore, whenever new road building is pursued and the road density exceeds or will exceed 1.7 miles/mile² in a third order or greater drainage, then the risks associated with culvert failure should be evaluated. Where there are a large number of undersized culverts, such as those that cannot at least pass a 25-year storm even, then timber harvest activities should account for this risk in determining overall potential cumulative impacts. It may be necessary to reduce the sediment loading risk from culvert failure to offset additional sediment loading risk associated with new culverts on a case-by-case basis to ensure consistency with the water quality goals of this section. Similar to the road sediment allocation, a given landowner can only be expected to address undersized culverts on roads under their ownership, although the total road density indicator value must consider roads under all ownership including abandoned roads where culverts may still be in place.

5.2 Arrastra Creek

5.2.1 Targets

5.2.1.1 Biota and Percent Fines Targets

Arrastra Creek water quality targets presented in Table 5-3 address biological integrity as measured by macroinvertebrates and periphyton. The targets also address substrate composition as measured by McNeil Core sampling. These targets and their applicability are the same as the targets for the Blackfoot River (Section 5.1.1). All considerations discussed for the Blackfoot River targets also apply to the Arrastra Creek targets presented in Table 5-3 except the specific monitoring sites further defined in Section 8.0. Note that existing conditions either satisfy or come very close to satisfying the Table 5-3 targets.

Table 5-3. Water Quality Targets for Arrastra Creek, Existing Conditions, and Departure from Target.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Macroinvertebrate and periphyton assemblages will score within full support of beneficial uses for sediment and habitat related indicators	Periphyton data indicate full support Macroinvertebrate data indicate impairment at one of two sampling locations	Target currently satisfied. Target not satisfied; but close to being satisfied (78% vs. 83% reference criteria per Appendix B).
Clinger taxa richness will be ≥ 14	Clinger taxa richness indicates impairment at the downstream location with a value of 13	Downstream location needs a small increase in taxa richness from 13 to 14 to meet the target.
The median of percent fines < 2.38 mm in McNeil core samples will be $\leq 15\%$	Medians values from 1999 to 2001 range from 13 to 14%; median values from 1993 to 1996 range from 9 to just above 15%	Recent data indicates that target is satisfied.
The median of percent fines < 6.35 mm in McNeil core samples will be $\leq 29\%$	Median values range from 1999 to 22% to 30%	Ranges from satisfying the target in the upper reach to exceeding the target by a small amount (30% vs. 29%) in the lower reach.

5.2.1.2 Additional Targets Based on Habitat and Aggrading Conditions

Table 5-4 presents additional target conditions to ensure overall full support of beneficial uses in Arrastra Creek. These targets address riparian health and in-stream habitat indicators associated with channel conditions and potential aggradation impacts as well as potential contributions to excess fines loading. Arrastra Creek was not assessed in 2002 using the modified EMAP or bank erosion methods as other impaired waterbodies were. Instead, results from a 1996 Forest Service assessment were used to evaluate similar parameters (Appendix H). The 1996 data indicates riparian health impacts and aggrading conditions that are causing additional sediment and/or habitat impairments. McNeil Core sampling and associated fines targets may not sufficiently characterize this condition. This is because the sediment size gradation associated with aggrading conditions may be larger than 6.35 mm on average, and aggraded areas may no longer support spawning and thus would not be sampled using McNeil Cores.

Two water quality specialists performed a field reconnaissance along the lower five miles of this stream during 2002 to supplement the 1996 assessment data (Appendix E). The 2002 results indicate high width to depth ratios, a lack of pools, and other indicators consistent with the aggradational characteristics noted in the 1996 Forest Service assessment. The observers also noted aggradational areas apparently caused by undersized culverts. A 2001 DEQ stream reassessment of Arrastra Creek (DEQ, 2003) identified lateral bank erosion and mid-channel bars. Some of the impairment indicators were associated with a road crossing and improperly sized culverts leading to aggrading conditions above the culverts. The three assessments

described above justify development of the additional Table 5-4 targets to address riparian health and channel indicators. The overall goal is to provide bank erosion protection via healthy riparian vegetation. This will reduce sediment loading from banks and subsequent channel aggradation, and will help ensure that the stream reaches its potential regarding sediment transport capabilities.

Appendix E provides information to justify target development using width to depth ratios, and Appendix H provides information to justify target development using riparian health and other channel indicators. Appendix E results suggest desirable bank full width to mean depth ratios are less than 25. This is based on an internal reference approach using information from a portion of Sub-reach AC1. Therefore, a bank full width to depth maximum ratio of 25 is applied as a target condition for Sub-reaches AC1 and AC2 as defined in Appendix E. Because of the depositional nature of Sub-reach AC3, and associated beaver dam impacts, this particular width to depth target is not applied in this lower area that extends from the mouth 0.75 miles upstream.

Appendix H suggests a potential for improved riparian conditions. Desirable riparian species comprised of sedge/rush, riparian shrub, or riparian trees comprise approximately 76% of Reach 4 based on the 1996 assessment results (Table H-1). Similar desirable riparian species values range from 50% along Reach 2 to 63% along Reach 1. The riparian target is set at 75% for the combination of desirable riparian species, based on Reach 4 results. This target is further supported by the fact that Reach 4 has about 95% stable, vegetated banks whereas Reaches 2 and 1 have about 73% and 52% stable, vegetated banks, respectively (Figure H-2). If a different assessment approach is developed to measure target compliance, then this value may be adjusted based on new internal or other reference values through the adaptive management approach (Section 7.0).

For beneficial use support, the width to depth and riparian targets must be met. A more direct measure of aquatic habitat, such as percent pools, may provide a more desirable measure of beneficial use support than width to depth measures. The assessment results described above did not provide adequate data to develop such a target. As part of implementation monitoring, (Section 8.0), an additional target based on in-stream channel conditions such as percent pools, can be developed for the lower five miles of Arrastra Creek. This target may be used in place of, or in combination with, the width to depth target.

An additional performance based target applies to the aggraded channel conditions above undersized culverts. These culverts need to be evaluated to determine potential culvert-related impediments to flow and sediment transport, and overall contributions to upstream sediment accumulations. The culverts should at a minimum be capable of passing a 25-year flood event based on forest road BMPs. This is not a strictly applied target. The target can be satisfied if the culvert can pass an event approaching a 25-year event, upstream habitat impacts are not significant when compared to conditions within the lower five miles of stream, and all Table 5-3 and 5-4 target conditions are otherwise satisfied.

The Table 5-4 targets apply to the lower 5 miles of Arrastra Creek consistent with the length of stream assessed in 1996 and 2002. Meeting the targets will be based on an assessment of representative reaches along the lower 5 miles of Arrastra Creek, either using methodologies

similar to the above referenced assessments or an equivalent methodology acceptable to DEQ and stakeholders. Representative reaches can be selected based on aerial analyses and/or physical observations so that the overall conditions can be adequately summarized in the lower sections of the drainage. The assessment methodology must quantify riparian health and quantify target conditions relative to a reference or least impaired condition as defined in Section 1.4.

As with other targets, attainability is always a factor. The lower reach is influenced by beaver activity and represents a depositional area that may have naturally high width to depth ratios and other depositional indicators. Care must be taken in applying targets in this reach, which is why the width to depth target is not applied. The setting of pool or other habitat related in-stream targets must consider naturally achievable sediment transport capabilities. This will need to include an evaluation of historic riparian structure regarding the potential for a higher percentage of large trees and their contribution to stream bank stability and large woody debris. Conversely, the potential for large natural sediment loads in the drainage and location of natural depositional areas must also be considered.

Table 5-4. Additional Water Quality Target for Arrastra Creek to Address Additional Habitat and/or Sediment Impairments.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Width to Depth ≤ 25 for upper stream segments (0.75 mi above mouth)	Ranges from 20 to 40 in reaches from about 1 mile above the mouth to about 5 miles above the mouth	Target not met in upper assessed reaches; target not applied to lowest reach
Desirable riparian species comprise $> 75\%$ based on FS 1996 assessment method	Values from three reaches are 50%, 63% and 76%	Target not met in lower two reaches
Restore sediment transport capabilities at undersized culverts; ensure 25 year storm passage capability	Up to 200 feet of aggraded channel is associated with potentially undersized culverts; existing flood passage unknown	Unknown

5.2.2 Total Maximum Daily Load

The Arrastra Creek sediment TMDL is based on a percent load reduction, similar to the sediment TMDL developed for the Blackfoot River between Landers Fork and Nevada Creek. The McNeil Core samples imply that only a small percent reduction in loading is necessary to meet the percent fines target, whereas the clinger taxa richness, riparian health, and width to depth targets suggest a more significant improvement in water quality is necessary. The Appendix H results indicate that a potentially greater overall reduction of in-stream sediment load is needed to provide full beneficial use support. Table 5-2 has already identified a 30% load reduction for sediment delivery from roads in support of the Blackfoot River sediment TMDL. This is used as the basis for the Arrastra Creek sediment TMDL, which is defined as a 30% decrease in total

sediment load from eroding banks and roads, as well as a 30% decrease in sediment load accumulation within the stream channel due to undersized culverts and reduced stream transport capabilities. This TMDL addresses attainment of the targets established for fine-grained sediment fractions as well as potential larger size fractions of sediment associated with aggrading conditions.

5.2.3 Allocations and Land Use Indicators

5.2.3.1 Allocations

The allocations for the Arrastra Creek sediment TMDL are presented in Table 5-5. The allocation for sediment delivery from roads is the 30% reduction applied to other roads in the watershed to meet the Blackfoot River TMDL (Section 5.1.2). A second, similar sediment load reduction is applied to eroding banks and the loss of sediment transport capabilities due to existing and historical human impacts on riparian health and channel dimension, pattern and profile. Undersized culverts are included as part of this allocation since they reduce sediment transport capabilities. The allocation is a 30% reduction in sediment loading to the stream and sediment deposition within the channel. The primary approach to satisfying this allocation is via improved riparian health based on the assumption that improved riparian health will result in reduced bank erosion. This assumption is supported by information provided in Figures H-1 and H-2, where increases in desirable vegetation cover in Reach 4 is associated with a high percentage of stable, vegetated banks. Furthermore, the increase in desirable vegetation and improved bank stability is expected to reduce width to depth ratios and increase sediment transport capabilities. This will contribute to decreased sediment accumulation within the stream and will improve fisheries habitat. Additionally, the percentage of large trees should also be increased if historical or other information suggests that the stream should have a higher percentage of large trees. In addition to potential sediment transport improvements, the larger trees will contribute to an increase in large woody debris over time, further improving aquatic life and fishery habitat. A third and final performance-based allocation applies to any future storm water permits. This allocation will be similar to the storm water permit allocation defined in Section 5.1.3.1 and Table 5.2.

One of the uncertainties associated with the Arrastra Creek targets, TMDL and allocations is a source assessment linking reduced riparian vegetation and associated bank erosion to existing or historical human activities. This will likely require further evaluation as part of the effort to evaluate progress toward achieving targets (Section 8.0) and evaluate target achievability. This will be an important adaptive management component for Arrastra Creek.

Another uncertainty is the origin of excess sediment loads within aggraded portions of the channel. A high percentage of Arrastra Creek has elevated potential for sediment yield (Appendix M), indicating a high potential for natural background loading. It also represents a higher potential for accelerated loading from timber harvest or grazing impacts. It is recognized that recent management activities are more likely to apply BMPs and that most loading may be within the range of naturally occurring. Nevertheless, it is possible that a significant percent of the sediment load associated with aggradational conditions is associated with historical harvest or grazing activities.

Table 5-5. Allocations for Arrastra Creek.

Sediment Source Category	Allocations
Sediment Delivery from Roads.	30% reduction of sediment loading from all roads in the watershed (about a 5.7 ton modeled reduction.)
Eroding banks and loss of sediment transport capabilities due to existing and historical human impacts on riparian health and channel dimension, pattern and profile. This includes undersized culverts.	30% reduction in sediment loading to the stream and sediment deposition within the channel.

5.2.3.2 Land Use Indicators

All the same land use indicators applied to the Blackfoot River also apply to Arrastra Creek drainage. Given the large percent of area with elevated potential for sediment loading, and potentially sensitive main stem conditions, it would be worthwhile to calculate the existing water yield using the ECA method, and to perform some field evaluations of BMP success in high sediment risk areas with recent harvest. Also, the road density indicator has been exceeded. Landowners should evaluate their existing culvert capacities and overall risks of failure and subsequent sediment loading potential.

5.3 Poorman Creek

5.3.1 Targets

5.3.1.1 Biota and Percent Fines Targets

Poorman Creek water quality targets presented in Table 5-6 address biological integrity as measured by macroinvertebrates and periphyton. The targets also address substrate composition as measured by McNeil Core sampling and by the 49-point grid. The biological and McNeil Core targets and their applicability are the same as the targets for the Blackfoot River (Section 5.1.1). All considerations discussed for the Blackfoot River targets also apply to the Poorman Creek targets presented in Table 5-6 with the exception of the specific monitoring sites defined in Section 8.0.

The median percent surface fines target using the 49-point grid in pool tails provides a measure of potential impacts to spawning fish as well as aquatic life. To satisfy the target, the median value of 49-point grid results must be $\leq 6\%$ based on the 75th percentile for the reference data for Reaches 1 and 2 of the Blackfoot River (Figure E-5 in Appendix E). The approximate 10% median value measured in Poorman Creek is higher than this 6% value based on the results presented in Figure E-5. Monitoring to satisfy this target needs to focus on two or three

representative reaches of Poorman Creek. This target must be met to satisfy the Poorman Creek siltation listing similar to the other targets presented in Table 5-6.

Note that existing conditions either satisfy or come very close to satisfying the Table 5-6 targets, with the exception of the targets for percent fines < 6.35 mm. Recent McNeil Core sampling resulted in median values near 37% for both 2000 and 2001. These values are well above the 29% target value. Also, the existing 15% condition for the 49-point grid target is well above the target value of 5%.

Table 5-6. Water Quality Targets for Poorman Creek, Existing Conditions, and Departure from Target.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Macroinvertebrate and periphyton assemblages will score within full support of beneficial uses for sediment and habitat related indicators	Periphyton assemblage data indicate full support	Target currently satisfied
	Macroinvertebrate assemblage data indicate full support	Target currently satisfied
Clinger taxa richness will be ≥ 14	Clinger taxa richness indicates impairment at one of three locations with values ranging from 13 to 18	Slight increase in taxa richness (from 13 to 14) required at one of three sites to fully meet the target
The median of percent fines < 2.38 mm in McNeil core samples will be $\leq 15\%$	Medians values from 1996 to 2001 range from 7% to 17%	Data suggests conditions close to satisfying target, only one year in five since 1996 exceeded 15% (17% vs. 15% for 2000)
The median of percent fines < 6.35 mm in McNeil core samples will be $\leq 29\%$	Median values range from 1996 to 2001 range from 28% to 37%	Recent three years of data all exceed target, with two most recent medians values for 2000 and 2001 both near 37% vs. the 29% target
The median percent fines < 6.35 mm in pool tails measured with a 49-point grid will be $\leq 6\%$	Median values approximately 10%	Median surface fines values in pool tails need to be reduced from 10% to 6% or less

5.3.1.2 Additional Targets Applied to the Lower Reach of Poorman Creek

The lower reach of Poorman Creek (PC5) was not assessed using the modified EMAP, although field reconnaissance identified channel and riparian concerns as well as dewatering impacts above the confluence with Grantier Spring Creek. To ensure full support conditions for aquatic life, additional sediment target requirements are applied to this reach above Grantier Spring

Creek as presented in Table 5-7. A modified EMAP (or equivalent assessment) will be required on this reach to ensure that channel and riparian conditions in Reach PC5 are comparable to internal or other applicable reference conditions.

For width to depth target development, Figure E-3 in Appendix E indicates a potential value, based on the modified EMAP protocol, of less than 22 using the 75th percentile of upstream reaches. For riparian health, the EMAP riparian evaluation, or other suitable method to measure riparian health, can be applied. In addition to the Table 5-7 target requirements, this lower reach will also be monitored to ensure compliance with the Table 5-6 biota and fines targets. Meeting these targets will ensure full support conditions as they related to any potential sediment impairment.

Table 5-7. Additional Sediment Targets Applied to Lower Reach (PC5) of Poorman Creek.

Width to depth and riparian health values in Reach PC5 comparable to internal or other applicable reference reaches	Not quantified, currently not satisfying targets based on professional observations	Not quantified
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5.3.1.3 Targets and Goals to Address Specific Habitat Impairments and Reduced Flows

Table 5-8 presents additional targets to address very specific habitat impairments. A performance-based target applies to the placer-mined areas along Poorman Creek. Much of Poorman Creek has been placer mined, some segments to a greater extent than others. Many of the placer-mined areas have relatively healthy vegetation and stable channel conditions. Although these placer-mined segments have revegetated, the channel can lack the hydraulic complexity that makes for good habitat. The level of aquatic life impact due to habitat loss varies significantly, with more significant impacts noted in Reach PC4 (Appendix E). The target applied to the placer mine areas includes the following conditions:

- Establishment of a functioning, native riparian community;
- Development of a dynamically stable channel configuration, with appropriate range of substrate type, pool/riffle ratio, width to depth ratio, entrenchment ratio, and sinuosity with respect to site potential.

Prior to any restoration efforts, feasibility studies will be performed to evaluate the aquatic life gains, the risks involved with physical stream restoration, and overall costs and benefits for each impacted sub-reach. The target only applies to those areas where restoration efforts are considered feasible. Input from fisheries biologists and water quality specialists, as well as key stakeholders, will be a critical component of any such decisions.

Another performance-based habitat target applies to potential fish passage barriers within Poorman Creek and its tributaries, which are identified and discussed in Appendix E and Appendix K. This target requires evaluation of fish passage potential at desirable migration

points as identified by fisheries biologists. Where a culvert is negatively impacting fish passage, and such passage is considered to be significant for overall aquatic life and cold-water fish beneficial use support, then the culvert must be upgraded to allow passage in order to satisfy this target.

A final water quality goal not presented as a target in Table 5-8 addresses the lack of flow during summer in the lower part of Poorman Creek. The goal is to increase flow to Poorman Creek to provide improved habitat for aquatic life. This can be particularly important in this stream since Poorman Creek serves as a migration corridor for spawning bull trout. Although increased flows would improve aquatic life and cold-water fish use support in Poorman Creek, any attempts to satisfy this goal must be in recognition of Montana Law regarding TMDL development and water quality planning. This law states “Nothing in this part may be construed to divest, impair, or diminish any water right recognized pursuant to Title 85” (Montana Water Quality Act §§75-5-705). Another important consideration regarding flow expectations is the apparent natural intermittent condition of the lower portion of Poorman Creek. Recent BMPs and water leasing agreements may be adequate to satisfy this goal.

Table 5-8. Targets to Address Specific Habitat Impairments in Poorman Creek and Tributaries to Poorman Creek.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Channel restoration in reaches altered by placer mining	Habitat in many placer-mined reaches does not provide suitable habitat for fish	Limited quantitative data
Culverts upgraded to allow fish passage where such passage is considered of significant importance	Assessments indicate fish passage limitations at several culverts	Not quantified

5.3.2 Total Maximum Daily Load

The McNeil Core and 49-point grid sampling suggest that sediment loading needs to be significantly reduced in Poorman Creek in order to meet targets and support beneficial uses. The Poorman Creek sediment TMDL will be consistent with the Arrastra Creek and Blackfoot River sediment TMDLs since roads and eroding banks are probably the two most significant sources of excess fine sediment loading from human activities. Therefore, the Poorman Creek sediment TMDL is expressed as a 30% decrease in sediment delivery from roads and a 75% reduction in bank erosion associated with human impacts. Note that this reduction is not based on the total bank erosion load since the assessment results did not provide this type of information. It is instead consistent with the percentage of human related bank erosion considered controllable along the Blackfoot River main stem (Appendix F).

5.3.3 Allocations and Land Use Indicators

5.3.3.1 Allocations

The allocations for the Poorman Creek sediment TMDL are presented in Table 5-9. The allocation for sediment delivery from roads is the 30% reduction applied to roads in other portions of the watershed to meet the Blackfoot River TMDL (Section 5.1.2). The allocation applied to accelerated bank erosion from human activities is a 75% reduction. As discussed above, this reduction is not based on the total bank erosion load since the assessment results did not provide this type of value. It is instead consistent with the percentage of human related bank erosion considered controllable along the Blackfoot River main stem (Appendix F). The assessment results indicated grazing impacts from horses and cattle, and noted the potential for improved riparian conditions in grazed areas as well as in areas where private homes and yards encroach upon streams. Also, some bank erosion in placer-mined areas was identified. The intent is to address bank erosion in the main stem as well as tributary drainages since bank erosion within tributaries has the potential to contribute to excess fines in the Poorman Creek main stem (and ultimately the Blackfoot River). Efforts to implement BMPs along Poorman Creek and tributaries to Poorman Creek, as discussed in Section 6.0, can reduce this bank erosion and satisfy the intent of this allocation.

The intent of the flow allocation is to help ensure a healthy riparian community in the lower section of Poorman Creek to help protect stream banks from erosion. The flow can also help avoid excess fine sediment accumulation due to a lack of transport capabilities. As stated above (Section 5.3.1.3), any efforts to address this allocation must be done in recognition of valid water rights. Also discussed in Section 5.3.1.3 is the fact that recent BMPs and water lease agreements may be adequate to address this allocation.

Allocations are not developed for the habitat impairment targets identified in Table 5-8. The placer mining and road building activities responsible for the habitat impairment conditions are inherently linked to the corrective actions as described in Section 5.3.1.3.

Table 5-9. Allocations for Poorman Creek.

Sediment Source Category	Allocations
Sediment Delivery from Roads	30% reduction of sediment loading from all roads in the watershed
Accelerated Stream Bank Erosion from Human Impacts in the Poorman Creek Drainage	75% reduction in eroding banks load associated with human impacts
Lack of flow during July through September	Increased stream flow conditions while not compromising valid water rights.

5.3.3.2 Land Use Indicators

All the same land use indicators applied to the Blackfoot River also apply to Poorman Creek drainage. Given the large percent of area with elevated potential for sediment loading, and bank

erosion concerns along the main stem, the existing water yield using the ECA method should be calculated, and field evaluations of BMP success in high sediment risk areas with recent harvest should be performed. Also, the road density indicator has been exceeded. Landowners should evaluate their existing culvert capacities and overall risks of failure and subsequent sediment loading potential.

5.4 Willow Creek

5.4.1 Targets

5.4.1.1 Biota and Percent Fines Targets

Willow Creek water quality targets presented in Table 5-10 address biological integrity as measured by macroinvertebrates and periphyton. The targets also address substrate composition as measured by the 49-point grid. The biological targets and their applicability are the same as the targets for the Blackfoot River (Section 5.1.1). All considerations discussed for the Blackfoot River biota targets also apply to the Willow Creek targets presented in Table 5-10 with the exception of the specific monitoring sites defined in Section 8.0. Note that existing conditions either satisfy or come close to satisfying the Table 5-10 biota targets.

The median percent surface fines target using the 49-point grid in pool tails provides a measure of potential impacts to spawning fish as well as aquatic life. To satisfy the target, the median value of 49-point grid results must be $\leq 6\%$ based on the 75th percentile for the reference data for Reaches 1 and 2 of the Blackfoot River (Figure E-5 in Appendix E). The approximate 8% median value measured in Willow Creek is higher than this 6% value based on the results presented in Figure E-5. Monitoring to satisfy this target needs to focus on two or three representative reaches of Willow Creek. McNeil Core sampling targets can be applied instead of, or in addition to the grid toss target if suitable native salmonid spawning areas can be located for sampling purposes. The target values would be the same 15% and 29% percent fines limits applied to fines < 2.38 mm and < 6.35 mm respectively. The grid toss and/or the McNeil core target(s) must be met to satisfy the Willow Creek siltation listing similar to the other targets presented in Table 5-10. In evaluating target compliance and overall achievability of the fines target, consideration must be given to potential impacts that a system with significant beaver activity may have, particularly on the lower sections of Willow Creek.

Table 5-10. Water Quality Targets for Willow Creek, Existing Conditions, and Departure from Target.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Macroinvertebrate and periphyton assemblages will score within full support of beneficial uses for sediment and habitat related indicators	Periphyton data indicate full support Macroinvertebrate data indicate impairment at one of two sampling locations	Target currently satisfied Target not satisfied; but close to being satisfied (72% vs. 75% of reference per Appendix B)
Clinger taxa richness will be ≥ 14	Clinger taxa richness data indicate full support	Target currently satisfied
The median percent fines < 6.35 mm in pool tails measured with a 49-point grid will be $\leq 6\%$	Median values are approximately 8%	Median surface fines values in pool tails need to be reduced from 8% to 6% or less

5.4.1.2 Additional Habitat and Sediment Targets

Table 5-11 presents additional targets to address the habitat impairment reach below the West Flesher Road. The target applied to this reach includes the following conditions:

- Establishment of a functioning, native riparian community;
- Development of a dynamically stable channel configuration, with appropriate range of substrate type, pool/riffle ratio, width to depth ratio, entrenchment ratio, and sinuosity with respect to site potential.

Because this reach is characterized by degrading conditions with eroding banks, apparent excess percent fines, and possible pool filling, the above target conditions must be met to address both habitat alterations and sediment related impairments. Target values for the functioning riparian community can be similar to riparian targets developed for Arrastra Creek (Table 5-4). Target values to address channel conditions can be similar to Arrastra or Poorman Creek targets, supplemented by literature values. These literature values should be based on the stream's potential using the Rosgen classification system and associated parameter ranges (Rosgen, 1996).

Another performance-based target focused on habitat alteration impairments applies to potential fish passage barriers within Willow Creek. One fish passage concern at the Flesher Road (Highway 279) crossing is identified and discussed in Appendix E. This target requires that fish passage be re-established at desirable migration points as identified by fisheries biologists.

Table 5-11. Additional Targets to Address Additional Habitat and Sediment Impairments in Willow Creek Drainage.

Water Quality End Point/Target	Existing Condition	Departure from Target or Percent Change Needed to Satisfy Target
Establish native riparian community and establish dynamic proper functioning condition based on stream potential for incised reach below West Flesher Road	Not properly functioning based on riparian health limitations and degraded channel conditions	Significant departure from target conditions, not quantified
Culverts upgraded to allow fish passage where such passage is considered of significant importance	Assessments indicate that at least one culvert location (Highway 279 crossing) causes a fish passage barrier	Not quantified

5.4.2 Total Maximum Daily Load

The 49-point grid sampling and biota results suggest that large reductions in sediment loading are not necessary to meet target conditions throughout most of the drainage. The Willow Creek sediment TMDL will be consistent with the Arrastra Creek and Blackfoot River sediment TMDLs since roads and eroding banks are probably the two most significant sources of excess fine sediment loading from human activities. Therefore, the Willow Creek sediment TMDL is expressed as a 30% decrease in sediment delivery from roads (including Highway 279) and a 75% reduction in bank erosion associated with human impacts. Note that this reduction is not based on the total bank erosion load since the assessment results did not provide this type of information. It is instead consistent with the percentage of human related bank erosion considered controllable along the Blackfoot River main stem (Appendix F).

5.4.3 Allocations and Land Use Indicators

5.4.3.1 Allocations

The allocations for the Willow Creek sediment TMDL are presented in Table 5-12. The allocation for sediment delivery from roads is the 30% reduction applied to roads in other portions of the watershed to meet the Blackfoot River TMDL (Section 5.1.2). The allocation applied to accelerated bank erosion from human activities is a 75% reduction. As discussed above, this reduction is not based on the total bank erosion load since the assessment results did not provide this type of value. It is instead consistent with the percentage of human related bank erosion considered controllable along the Blackfoot River main stem (Appendix F). The assessment results did not identify many existing grazing or other impacts leading to bank erosion, and historic assessment results did not identify significant bank erosion concerns (DEQ, 2003). The intent is to address bank erosion in the main stem as well as tributary drainages, including Sandbar Creek, since bank erosion within tributaries has the potential to contribute to excess fines in the Willow Creek main stem (and ultimately the Blackfoot River). Efforts to

implement BMPs along Willow Creek and tributaries to Willow Creek, as discussed in Section 6.0, can reduce this bank erosion and satisfy the intent of this allocation.

Note that the Table 5-12 bank erosion allocation is not applied to the reach between the West Flesher Road and Sandbar Creek until channel dimensions meet target values within Table 5-11. This is because additional bank erosion may be part of the natural recovery process for this reach as the stream attempts to increase sinuosity and build a new floodplain. To facilitate this effort, a performance-based allocation is developed. This performance-based allocation is based on two components. The first component involves continued implementation and evaluation of grazing BMPs. The goal is to protect riparian vegetation and avoid damage to developing floodplain areas. The second component is removal of any floodplain restriction associated with the upstream bridge crossing at West Flesher Road. The assessment results (Appendix E) identified this bridge crossing as a potential floodplain barrier. Limiting flood flows could hinder recovery of the downstream impaired reach while at the same time increasing sediment loading risk due to culvert failure. Therefore, to satisfy this second performance-based component of the allocation, the bridge crossing should be able to at least pass a 25-year flood with minimal pooling.

Physical restoration of all or portions of the impaired reach between West Flesher Road and Sandbar Creek is also an option. This could include anywhere from complete design and construction of a new channel to riparian plantings in recovering areas. Prior to any significant physical channel restoration efforts, a feasibility study should be performed to evaluate the aquatic life gains, the risks involved with physical stream restoration, and overall costs and benefits. Input from fisheries biologists and water quality specialists, as well as key stakeholders, will be a critical component of any such decisions. An additional recommendation associated with recovery of this stream reach is to allow continued downstream beaver colonization. Downstream beaver dams may contribute to grade recovery and help restore floodplain and ground water levels, which would assist with riparian recovery.

The performance-based road sanding allocation is based on ongoing efforts by the Montana Department of Transportation to incorporate BMPs. This is applied in the same manner as for the Blackfoot River allocation associated with road sanding (Section 5.1.3.1). Similar to the Blackfoot River, it is anticipated that the BMPs, once implemented, will ultimately lead to a percent reduction of road sand loading to Willow Creek consistent with the sediment TMDL reduction of 30% for roads.

Allocations are not developed for the habitat impairment target associated with fish passage. The highway and other road building activities responsible for fish passage impairments are inherently linked to the corrective actions as described in Section 5.4.1.2.

Table 5-12. Allocations for Willow Creek.

Sediment Source Category	Allocations
Sediment Delivery from Roads	30% reduction of sediment loading from all roads in the watershed
Accelerated Stream Bank Erosion from Human Impacts in the Willow Creek Drainage	75% reduction in eroding banks load associated with human impacts; not applied to reach between W. Flesher Rd and Sandbar Creek until channel dimensions meet target values
Historic impacts to channel above Sandbar Creek and below W. Flesher Rd crossing	Performance-based; a) continued implementation and evaluation of grazing BMPs; b) remove floodplain restriction by ensuring passage of at least a 25-year flood with minimal pooling at the W. Flesher Rd crossing
Road Traction Sanding	Based on development and implementation of road sanding BMPs (performance-based allocation)

5.4.3.2 Land Use Indicators

All the same land use indicators applied to the Blackfoot River also apply to the Willow Creek drainage. Willow Creek has a relatively large percent of area with elevated potential for sediment loading, but did not have significant recent harvest based on 1992 through 1999 information. In fact, there was little harvest within the whole watershed within this time period. This suggests that hillslope and water yield indicators are not exceeded and additional analyses regarding hillslope erosion BMP implementation or water yield may not be a priority. On the other hand, the road density indicator has been exceeded. Landowners should evaluate their existing culvert capacities and overall risks of failure and subsequent sediment loading potential.

5.5 Sandbar, Beartrap, Mike Horse Creeks and the Upper One-Mile of the Blackfoot River

Sandbar Creek, Beartrap Creek, Mike Horse Creek, and the upper one-mile of the Blackfoot River are all impaired due to habitat alterations. The target condition for these streams is a restored channel in the locations where mining activities and highway encroachment have degraded habitat conditions. Target and restoration objectives include the following:

- Establishment of a functioning, native riparian community;
- Development of dynamically stable channel configuration, with appropriate ranges of substrate type, pool/riffle ratio, width to depth ratio, entrenchment ratio, and sinuosity with respect to site potential.

Consequently, the goal is to restore the stream to a stable dimension, pattern, and profile that is in dynamic equilibrium such that the stream system neither aggrades nor degrades. The reconstructed channel will also provide higher quality habitat for fish and aquatic life.

Surrogate allocations address the extent to which mining and road building activities have altered channel morphology and habitat condition in these streams. These reaches will be restored to a

functioning stream as described above. Compliance with the channel restoration target will be based on assessment work documenting achievement of each of the above objectives. Additionally, biota targets for periphyton and macroinvertebrate, as described in Table 5.1 for the Blackfoot River, also apply.

SECTION 6.0

WATER QUALITY AND HABITAT IMPROVEMENT PLAN: IMPLEMENTATION STRATEGY

This section presents the overall strategy to achieve long-term land and water conservation goals of the Blackfoot Challenge and TMDL targets. The restoration of water quality and habitat conditions in the Blackfoot Headwaters Planning Area can be achieved through a variety of management or restoration strategies that fall into two categories: watershed-wide management activities to promote overall upland and stream health, and targeted strategies to address observed impairments on 303(d) listed streams.

There is considerable overlap in the Blackfoot Challenge's conservation objectives and the goals of the TMDL plan. However, some of the Blackfoot Challenge's concerns, such as weed management, lie outside the TMDL process. Nevertheless, this implementation plan provides a blueprint for addressing the full range of conservation issues including objectives for upland erosion management, weed management, grazing management, riparian health, road management, fisheries management, and other watershed health concerns. As a result, the voluntary activities presented here will result in full support of beneficial uses as described by numeric targets on impaired streams as well as meeting the Blackfoot Challenge's objectives for overall watershed health.

An important consideration in development of this restoration plan was the amount of specificity that was possible based on the available data. The large size of the Blackfoot Headwaters Planning Area presented a constraint in the development of highly detailed restoration plans. It was difficult to describe adequately conditions across such a large area as the vastness of the watershed precluded assessment of listed streams in their entirety. Instead, aerial photo analyses allowed for identification of sub-reaches, which provided the basis of a stratified approach. Field evaluations occurred in varying proportions of these sub-reaches within budgetary and time constraints. This approach allowed for development of a reach-based restoration plan that targets conditions observed in the reach. Still, the plan is flexible to account for conditions present in non-sampled portions of these sub-reaches that may require additional or different actions to meet restoration objectives. Site-specific assessment of each restoration strategy will determine its feasibility with respect to site constraints, cost, environmental benefit, and stakeholder support. Restoration strategies will be prioritized based on benefit and feasibility.

6.1 Watershed-Wide Long-Term Management Strategies

This portion of the plan provides system-wide restoration strategies to meet the qualitative goals of maximizing the long-term health of the Blackfoot upland, river, and tributary resources as well as specific goals of the TMDL process. These management strategies will be accomplished through voluntary cooperative private-public resource stewardship led by the Blackfoot Challenge and its partners.

6.1.1 Management of Erosion-Prone Hillslope Areas

This section of the plan identifies upland areas that due to steep slopes and highly erodible soils have the potential to deliver high sediment loads to streams if bare mineral soil is exposed and inadequate erosion control applied. Since vegetative cover plays a critical role in preventing hillslope erosion, the management strategies address land use practices that have the potential to expose bare mineral soil. The plan aims to decrease production and delivery of sediment from erosion-prone hillsides identified as sediment sources. The strategy to prevent or reduce erosion and sediment delivery in these areas is to implement best management practices (BMPs) when conducting forestry, grazing, and other land management activities.

Forestry Best Management Practices for Montana (Logan, 2001) is a voluntary program that requires that landowners be aware of unstable or erosion-prone areas when conducting forestry activities. If activities in these areas are unavoidable, managers should employ appropriate techniques to minimize the extent of the disturbance and apply erosion control practices on disturbed soils. For example, selection of appropriate harvesting systems (i.e., cable logging from roads on steep slopes rather than using tractors) and the reduction in the number of roads will reduce the area of disturbance. Where disturbance occurs, implementation of forestry BMPs will control erosion. For example, placement of logging slash (tree limbs, etc.) on the ground in erosion prone areas creates ground cover and prevents erosion. Lastly, retention of streamside buffers, as required under the Streamside Management Zone law, encourages deposition of any eroded soils prior to entering streams.

To address grazing-related disturbance, grazing best management practices (prescribed grazing) will be implemented as part of a range or allotment management plan. These plans are required on all land leased by Plum Creek Timber and the US Forest Service.

As forestry, grazing or other projects are developed in the areas identified as higher-risk in this TMDL, landowners will be encouraged to tailor their activities to address the unique hazards in these areas to prevent erosion and sediment delivery to streams. The Blackfoot Challenge will provide educational materials to landowners that will show where the higher-risk erosion areas are located in the watershed. Landowners can then incorporate this information into their land management planning.

6.1.2 Action to Decrease Sediment Loading and Improve Fish Passage

Surveys of road conditions indicate improvements and BMPs will reduce loading of sediment to streams from these sources. The USFS provided a detailed list of road improvements identified for the Poorman Creek drainage (Appendix K). Activities include replacing undersized culverts, improving blading practices, and reconfiguring roadbeds and ditches as necessary to decrease sediment load to streams. Promotion of a similar approach by the USFS and other major landowners for all forest roads in the planning area will ensure that the road crossing sediment load allocations are satisfied.

On county and private roads, the plan promotes actions that will improve road conditions. This includes identification of and completion of road improvements to replace undersized culverts,

mitigate bridge impacts on streams, and other actions to decrease sediment load to streams particularly at stream crossings. The plan also encourages the careful design and placement of new roads in subdivisions as well as routine maintenance of all subdivision roads to reduce sediment loading to streams. The goal is to apply the same or similar BMP standards to county and other private roads as are applied to roads built for timber harvest purposes. Identifying fish passage barriers on existing roads, and preventing creation of new barriers due to new road building activities is also an important goal.

Montana Department of Transportation (MDT) incorporates best management practices into their sanding efforts. These BMPs will vary from area to area, but in the upper Blackfoot may include the following:

1. Identification of sensitive areas where additional BMPs may be warranted;
2. Reduce the speed of plowing (when safe to do) to decrease the distance that snow/sand mix is blown from the highway;
3. Increase the use of chemical deicers and decrease the use of road sand, as long as doing so does not create a safety hazard or cause undue degradation to plant and water quality – a new combination sander/deicer with 800 gallon capacity has been added to the Lincoln section this year;
4. Improve maintenance records to better estimate the use of road sand and chemicals, and to estimate the amount of sand recovered in sensitive areas;
5. Continue to fund and manage MDT research projects, which will identify the best designs and procedures for minimizing road sand impacts to adjacent bodies of water, and incorporate those findings into additional BMPs;
6. Work with county road agents to share information and coordinate state-county road BMPs, continuing to pass-through funds to counties for road weed control; and
7. Identify areas with poor soil cover and explore options for revegetation to promote the growth of non-invasive species.

6.1.3 Plum Creek Timber Company

Plum Creek's Native Fish Habitat Conservation Plan (Plum Creek Timber Company, 2000) will guide water quality restoration in the Blackfoot Headwaters on Plum Creek lands. The US Fish and Wildlife Service and National Marine Fisheries Service approved this plan under Section 10 of the federal Endangered Species Act (ESA). The plan addresses the needs of native trout listed under the ESA (e.g., bull trout, redband rainbow trout, etc.) as well as species not presently listed (e.g., westslope cutthroat trout). In exchange for incidental take coverage for bull trout under the ESA, Plum Creek has committed to implement 56 conservation measures on their land, which will minimize and mitigate impacts to native fish. Measures that Plum Creek will be implementing under their Native Fish Habitat Conservation Plan (NFHCP) in the Blackfoot Headwaters area that will support attainment of the restoration goals and TMDL are summarized as follows:

- The NFHCP designates Plum Creek lands in the Arrastra and Poorman Creeks (above Landers Fork Confluence) as High Priority Watersheds. With this designation, Plum Creek will upgrade all roads to meet state BMP standards (with some specific

enhancements) by the end of 2010. This work will include improving general road drainage, reducing the length of road draining to streams, and adding supplemental filtration (e.g., slash filter windrows, silt fences, etc.) where drainage feature outfalls discharge too close to streams for effective filtration. Plum Creek lands in other watersheds in the Blackfoot Headwaters will have any necessary road improvements made by the end of 2015.

- Where fish passage barriers exist, they will be corrected prior to 2010 in high priority watersheds and 2015 elsewhere. This deadline may be extended if necessary to fully work out details with cost-share partners (e.g., USFS).
- New stream culvert installations will be designed to accommodate at least the 50-year peak flow.
- Roads that Plum Creek does not require for forest management will be abandoned (reclaimed) by the end of 2010.
- All roads will be periodically re-inspected for BMP conditions. In High Priority Watersheds, this will be at least every 5 years.
- While Plum Creek requires very few new roads in the Blackfoot Headwaters, should they be necessary they would be constructed to specific enhanced standards.
- In addition to standard state Streamside Management Zone regulations, Plum Creek will be providing extra riparian protection along some streams. Extra protection is targeted for watersheds that contain bull trout, streams with channel migration zones, and streams that have plane-bed forced pool riffle morphology. Riparian buffers must also be enhanced with additional leave trees when streamside roads inhibit recruitment on the opposite side of the stream.
- On Plum Creek grazing lands, grazing leaseholders must have an approved range management plan (RMP) each year. This plan describes the best management practices that will be applied to the range to maintain or improve conditions over time as necessary to achieve certain environmental targets set out in the NFHCP. These targets relate to the amount of livestock altered stream bank, riparian grass and shrub utilization, and riparian compaction. The RMPs typically describe the grazing system (deferred, rest rotation, etc.), water source development, fencing, etc. Additionally, the leaseholder and Plum Creek monitor the range twice annually.
- For more information on the NFHCP, the reader can visit Plum Creek's website at the following address: <http://www.plumcreek.com/environment/fish.cfm>.

6.1.4 Noxious Weed Management

Noxious weed infestations are pervasive in the upland areas and stream corridors of the Blackfoot River watershed. The noxious weed restoration strategy consists of an aggressive plan implemented through Blackfoot Challenge weed management program that currently coordinates the management of noxious weeds on 350,000 acres in the Blackfoot valley, designated weed management areas (WMAs). In the Blackfoot Headwaters Planning Area, the following additional strategies will be employed:

- Coordinate with existing and create new WMAs in the Blackfoot Headwaters to address watershed-wide and riparian weed management issues;

- Work with Lewis & Clark and Powell County weed boards and weed coordinators, assisting individual landowners with mapping of weeds, implementation of control measures, and obtaining additional funding to co-share chemical control, biological control, and revegetation; and
- Initiate riparian weed control projects in areas of bank erosion and local support.

6.1.5 Forest Stewardship and Grazing BMPs

The Blackfoot Challenge, in coordination with State and Federal agencies, will work with landowners on forest stewardship and grazing BMPs to meet the goals of this watershed restoration plan and TMDL. Several agencies provide technical assistance to private forest landowners interested in maintaining their timberlands including the Department of Natural Resources (DNRC) Service Forestry Bureau, Montana State University (MSU) Extension's Forest Stewardship Program, Lewis and Clark Conservation District, North Powell Conservation District and the Natural Resources and Conservation Service (NRCS). Together, these entities possess both the technical expertise and local knowledge to promote conservation and restoration efforts.

The Blackfoot Challenge, through its Conservation Strategies Committee, will be developing a cooperative forest stewardship program to promote sustainable timber and grazing management throughout the Blackfoot River watershed. Private and public landowners will be able to pool their resources and share management techniques to maximize timberland recovery and sustainable harvesting to retain a timber economy important to the rural lifestyle of the area. Grazing leases on public lands and Plum Creek Timber lands have helped to sustain the rural livestock industry. Effective grazing management strategies are critical to sustaining the long-term health of grazing lands. The Blackfoot Challenge, through its Conservation Strategies Committee, will offer technical assistance to private landowners seeking help with grazing management plans, in cooperation with its technical partners. This restoration strategy includes:

- Providing ongoing technical support to Blackfoot landowners on sustainable forest stewardship and grazing management BMPs; and
- Developing a cooperative forest stewardship program to promote sustainable timber management watershed-wide in a way that does not contribute to excessive sediment loading.

Specific BMPs that may be employed in the Blackfoot Headwaters Planning Area are presented in Table 6-1. Additional BMPs and land, soil and water conservations practices may also apply on a case-by-case basis. Agricultural BMPs will be consistent with acceptable standards such as Montana Conservation Practice Standards from NRCS Technical Guidance (DEQ, 2001).

Table 6-1. Summary of BMPs and Management Techniques.

Human Disturbance Type	BMP and Management Techniques	References
Grazing	Design a grazing management plan and determine the intensity, frequency, duration, and season of grazing to promote desirable plant communities and productivity of key forage species.	MT DNRC 1999
	Maintain adequate vegetative cover to prevent accelerated soil erosion, protect stream banks and filter sediments. Set target grazing use levels to maintain both herbaceous and woody plants. No grazing unit should be grazed for more than half the growing season of key species.	MT DNRC 1999 MT NRCS 2002
	Create riparian buffer exclosures through fencing.	MT DNRC 1999
	Ensure adequate residual vegetative cover and regrowth and rest periods. Periodically rest or defer riparian pastures during the critical growth period of plant species.	MT DNRC 1999
	Distribute livestock to promote dispersion and decomposition of manure and to prevent the delivery of manure to water sources.	MT DNRC 1999
	Alternate a location's season of use from year to year. Early spring use can cause trampling and compaction damage when soils and stream banks are wet. If possible, develop riparian pastures to be managed as a separate unit through fencing.	MT DNRC 1999 MT NRCS 2002
	Provide off-site high quality water sources.	MT DNRC 1999
	Periodically rotate feed and mineral sites.	MT DNRC 1999
	Place salt and minerals in uplands, away from water sources (ideally ¼ mile from water to encourage upland grazing).	MT DNRC 1999
	Keep salt in troughs and locate salt and minerals in areas where soils are less susceptible to wind or water erosion.	MT DNRC 1999
	Monitor livestock forage use and adjust strategy accordingly.	MT DNRC 1999
	Create hardened stream crossings.	MT DNRC 1999

Table 6-1. Summary of BMPs and Management Techniques.

Human Disturbance Type	BMP and Management Techniques	References
	Encourage the growth of woody species (willow, alder, etc.) along the stream bank, which will limit animal access to the stream and provide root support to the bank.	MT DNRC 1999
Forestry	Follow Montana Streamside Management Zone (SMZ) laws and voluntary wildlife guidelines and other forestry related BMPs. Montana's SMZ regulations require buffer widths that are 50 or 100 feet for streams with an adjacent slope of less than 35% and greater than 35%, respectively. Within the SMZ, in Class 1 streams, no more than 50% of trees greater than 8 inches in diameter are removed (maintaining a minimum of 10 trees per 100 feet of the SMZ). In Class 2 streams a minimum of 10 trees per 100 feet of SMZ must be left.	MT Dept of State Lands 1994 MT DNRC 1995 MSU Extension Service 2001
	The following practices are prohibited within the SMZ: broadcast burning, operation of wheeled or tracked equipment except on established roads, clearcutting, road construction (with the exception of stream and wetland crossings), storage or handling of hazardous materials, side-casting of road materials, and depositing slash in surface water.	MT Dept of State Lands 1994

Table 6-1. Summary of BMPs and Management Techniques.

Human Disturbance Type	BMP and Management Techniques	References
Invasive weeds	In areas where invasive weeds are present across several properties, develop cooperation among landowners and develop an integrated weed management plan. This can be accomplished through the establishment of a Weed Management Area (distinguishable areas based on similar geography, weed problems, climate, and human use patterns), which can provide a channel of communication among landowners and a conduit for funding sources. Work with the Blackfoot Challenge Weed Management Group to determine the best management alternative (cultural, biological, physical, and chemical).	Duncan 2001
	Educate landowners and recreational users as to weed identification and prevention techniques.	Duncan 2001
	Prevent establishment and spread by keeping site-disturbing vehicles on designated trails or roads, keeping animals free of weed seed when possible, and developing an early detection program.	Duncan 2001
	Inventory the species and extent of the infestation.	Duncan 2001
Floodplain Development	Floodplain buffer.	
	Bank line grading and revegetation.	
Bank hardening/riprap/revetment	Limit to demonstrated infrastructure threat. Where deemed necessary, apply bioengineered bank treatments to induce vegetative reinforcement of upper bank, and to provide shading and cover habitat.	
Mining (placer piles)	Reconfigure channel floodplain cross sections to ensure floodplain connectivity and access.	
	Riparian restoration.	
W:D ratio	As possible, encourage vegetative reinforcement of banks to prevent stream overwidening and w:d ratio increases.	

6.1.6 Drought and Water Conservation

Certain streams, notably the lower portion of Poorman Creek and Arrastra Creek in the Blackfoot Headwaters, suffer from dewatering and the effects of drought. Dewatering is a type of habitat alteration that negatively influences fish and associated aquatic life by reducing the amount and quality of available habitat for fish. Low flows can also contribute to an accumulation of excess fines on streambed surfaces due to a lack of flushing. Restoration strategies include:

- Implementation of the Blackfoot Challenge water conservation plan;
- Working with landowners in the lower Poorman Creek drainage to address dewatering; and
- Investigate causes and solutions to dewatering in Arrastra Creek.

6.1.7 Conservation of Intact Landscapes

Maintaining large intact landscapes protects the natural resources and rural lifestyle of the Blackfoot River watershed. Development pressures associated with these lands include construction of new roads, elimination of vegetative cover, and subdivision. These alterations to the landscape can increase runoff and sedimentation to streams, and reduce wildlife habitat. Restoration strategies to maintain the intact landscape in the Blackfoot include:

- Projects such as the Blackfoot Community Plum Creek Project to encourage large acreage ownership in the transfer of lands to adjacent landowners;
- Conservation easements to sustain working ranches and allow for expansion of working ranches; and
- Protection of critical wetlands and other areas of high natural resource values through North American Wetlands Conservation Act (NAWCA) grants and other funding sources.

6.2 Watershed-Wide Stream Corridor Restoration Strategies

Within the river corridor, a number of opportunities exist to improve stream function, riparian condition, fish habitat, and water quality. The TMDL planning effort identified numerous conditions along stream corridors that affect water quality, riparian health and function, fish habitat, and geomorphic stability. These include conditions such as eroding banks, encroachment of structures or roads on the floodplain, riparian degradation from grazing, infestation of noxious weeds, and presence of fish barriers. This section provides general prescriptions to address these conditions throughout the watershed for all streams, not just those identified as being impaired on the 303(d) list.

6.2.1 Revegetation

The revegetation of cleared riparian/floodplain areas with native vegetation will reinforce and anchor stream banks and over bank surfaces. In general, woody riparian understory species are

most effective at generating root masses that effectively increase stream bank resiliency. However, large trees are desirable for large woody debris and shade. Vegetated riparian banks also act to filter and hold fine sediment during periods of high flows. Revegetation restoration includes:

- Maintenance of a functioning native riparian and streamside vegetative community through riparian management techniques including revegetation and grazing BMPs.
- Establishment of woody debris concentrations that reflect typical recruitment rates within a stream environment.

6.2.2 Riparian Buffer

The implementation of a riparian buffer zone to limit stream encroachment from vegetation clearing and development can facilitate the management of the stream system as a channel/floodplain corridor rather than simply as a channel environment. Riparian buffers can also facilitate the growth of over story trees, which function as a source of large woody debris and provide shade as well as nutrient inputs to the channel. This riparian restoration plan encourages Lewis & Clark, Powell and Missoula counties to develop a consistent policy on appropriate setbacks from streams for habitable structures. This plan encourages:

- Establishing a minimum riparian buffer from the floodplain for all habitable structures to allow for natural channel migration and avoid the need for shoreline armoring to protect structures built too close to the migrating channel;
- Providing technical assistance to county commissions and conservation districts in developing maps that delineate the riparian buffer and creating a process for landowner setback exceptions; and
- BMPs for vegetative management within the riparian buffer of 100 feet from the floodplain to promote long-term riparian health and avoid erosion and sedimentation.

6.2.3 Riparian Grazing BMPs

Streamside areas provide high quality forage for livestock and these areas often sustain impacts in the absence of effective management schemes. This plan calls for implementation of grazing best management practices to restore the structure and function of riparian communities. A number of alternatives exist for managing livestock in riparian areas. Furthermore, the Blackfoot Challenge land steward and the Natural Resource Conservation Service technical staff are available to work with landowners to develop grazing management plans appropriate for their operations. The plan calls for technical assistance and support to landowners wanting to avoid riparian degradation and bank trampling. Specific BMPs include:

- Temporary exclusions where impacts are severe enough that several years of rest is required;
- Placement of riparian areas in conservation easements for extended periods; and
- Rotational grazing or cross fencing.

6.2.4 Fish Passage Barrier Removals

Numerous in-channel structures are potential fish passage barriers on Blackfoot River tributaries. These occur on forest roads, county roads, and private roads providing access to residences. Fish passage barrier restoration strategies include:

- Locate and perform fish passage assessments on all road crossings over stream segments where maintaining fish passage is a priority.
- Based on a priority list, culverts and other structures that create a barrier to fish migration will be inventoried and replaced with passable structures, except in streams where a barrier is desirable to prevent encroachment of brook trout into streams with westslope cutthroat trout populations.
- These activities will occur in consultation with fisheries biologists from MFWP and the USFS.

6.2.5 Non-Structural Erosion Control

Montana regulates streambed and bank disturbance with two permitting processes. One is the Natural Streambed and Land Preservation Act (310 Permit). This permit is required of private entities that want to undertake work that would modify the bed or immediate banks of perennial streams, and is administered by local Conservation Districts. The second is the Stream Protection Act (124 Permit), which applies to state and federal agencies, county and city governments and is administered by the Montana Department of Fish, Wildlife and Parks.

In addition, federal 404 permits, administered by the US Army Corps of Engineers, are required for activities along navigable waters. The USFWS and EPA are also involved in this process. The goal of these permit programs is to minimize adverse effects on shoreline and in-stream resources from human activities.

Installations of hardened erosion control structures can negatively affect long-term river function. Complete arrest of bank erosion eliminates the rejuvenating processes of channel migration and sediment cycling is lost, resulting in negative impacts on fish habitat. Although stream bank erosion control structures (revetments) can reduce localized sediment sourcing from bank erosion, their long-term adverse impact on overall channel function makes them undesirable management options. Channel migration is necessary for large woody debris recruitment that provides critical components of channel complexity and associated habitat elements such as pools resting areas, and cover. The restoration strategies focus on management practices that facilitate natural reinforcement of channel banks by riparian vegetation. The restoration plan encourages CDs, counties and local planning boards to promote:

- Non-structural erosion-control except to protect existing road and bridge infrastructure at risk, and even then mitigating down-stream erosion.
- Riparian buffer and revegetation in erosion areas.
- Case-by-case review of bank erosion focus areas working with landowners on non-structural erosion control solutions.

6.3 Restoration Strategies for 303(d) Listed Streams

This section presents specific restoration activities for the main stem of the Blackfoot River and its listed tributaries. The objective of these activities is to ensure fulfillment of load allocations established in Section 5.0 and achievement of full support of beneficial uses as defined by the numeric targets. This section addresses area-specific restoration activities for listed streams.

Delineation of sub-reaches on 303(d) listed streams facilitates planning. The Blackfoot River within the Blackfoot Headwaters Planning Area consists of seven major reaches delineated in the aerial photo analyses and field assessments (Figure 10). Geomorphic form (slope, sinuosity, cross section) and process (transport capacity, rates of change) provided the basis for delineation of these reaches. Each reach has designated activities intended to remedy problems identified in that reach. A delineation of sub-reaches on the 303 (d) Listed tributaries facilitates planning and prioritization of restoration activities.

Watershed-wide long-term management strategies (Section 6.1) and stream corridor restoration strategies (Section 6.2) apply across all streams as sound management practices. Consequently, even though weed management may not be identified specifically below, it is a prescribed restoration activity for all reaches. In addition to the general management strategies, specific restoration strategies will be applied on the 303(d) listed streams to address specific sediment and habitat impairments where needed. Finally, there may be channel restoration projects, yet to be identified, that are consistent with the Water Quality and Habitat Plan and will be incorporated into the plan at a later date.

6.3.1 Blackfoot River (Landers Fork to Nevada Creek)

Reach Prioritization

The first component of the restoration plan is prioritization of reaches for restoration activities. A simple analysis allowed for ranking of reaches in terms of the human-induced sediment loading from eroding banks. This was a summation of the length of eroding bank associated with the different types of human influence and calculation of the percent of the reach. Reaches were ranked by the extent to which human factors increase bank erosion in each reach. Analyses to support these rankings included correlations with human influences and bank erosion (Appendix F). In summary, the data indicate that on assessed reaches on the main stem of the Blackfoot, grazing followed by road/railroad crossings are the most significant source of bank erosion, followed by revetments, logging, and building.

Based on data and analysis contained in Appendix F, restoration efforts will be concentrated within Reaches 5 and 6, where the primary source of sediment loading is associated with human activities. These reaches form a continuous 24-mile channel segment that extends from river mile 42 near Lincoln, to river mile 18, which is located near the Highway 141 Bridge crossing. Within this 24-mile channel segment, primary impacts to the Blackfoot River and its floodplain to be managed include grazing and road encroachment (Table 6-2). Human influences occur along approximately 30% of eroding banks in these reaches. The river deposits that underlie the floodplain and terrace environments within this area tend to be relatively fine grained; as a result,

accelerated bank erosion results in entrainment of excessive fines, which is detrimental to fisheries.

Table 6-2. Total Combined Blackfoot River Bank Lengths Affected by Human Sources; Percent Refers to Relative Percentage of Each Type of Human Disturbance.

Human Influence	TOTAL ERODING BANK LENGTHS	% of Total Eroding Banks; All Reaches
Revetment	5549	8.7
Buildings	3454	5.4
Pavement	1451	2.3
Road/Railroad	15697	24.6
Pipes	676	1.1
Landfill/Trash	556	0.9
Park/Lawn	532	0.8
Grazing	31580	49.6
Logging	4227	6.6
Mining	0	0
Total	63,722	100

This section presents a restoration plan for the main stem of the Blackfoot River. Table 6-3 provides a summary of the reach ranking and restoration strategy of each reach. The objective of these activities is to ensure fulfillment of load allocations established in Section 5.0 and achievement of full support of beneficial uses as defined by the numeric targets.

Table 6-3. Summary of Identified Impacts and Proposed Treatment Strategies, Blackfoot River Study Reaches.

Major Reach	River Miles	Primary Identified Human Disturbance Factors	Priority Ranking	Human Yield (tons/mile)	Percent of banks affected by disturbance	Treatment/ BMP Strategies
BR1	55.1-70.0	Upper watershed mining, minor revetments and bank armoring	7	8.4	1.5	Incorporate geomorphic channel restoration into metals remediation strategies.
BR2	49.5-56.2	Roads, minor revetments and bank armoring, noxious weeds	5	28.41	3.8	Revegetate severely eroding stream banks and adjacent over bank areas. Implement weed management plan.
BR3	48.1-49.5	Roads, grazing, floodplain clearing and construction, noxious weeds, limited LWD; low vegetative cover and extensive bare ground	4	28.41	No data	Implement floodplain buffer to limit encroachment from clearing/development. Revegetate severely eroding stream banks and adjacent over bank areas. Implement weed management plan.
BR4	42.3-48.1	Roads, grazing, logging, floodplain development, rock and root wad revetment, and noxious weeds	3	99.7	22.8	Implement floodplain buffer to limit encroachment from clearing/development. Revegetate severely eroding stream banks and adjacent over bank areas. Encourage riparian grazing BMPs and riparian buffers. Implement weed management plan.
BR5	32.1-42.3	Grazing, logging activities, revetments, roads, and knapweed.	2	194.72	29.3	Encourage riparian grazing BMPs and riparian buffers. Revegetate severely eroding stream banks and adjacent over bank areas. Implement weed management plan.

Table 6-3. Summary of Identified Impacts and Proposed Treatment Strategies, Blackfoot River Study Reaches.

Major Reach	River Miles	Primary Identified Human Disturbance Factors	Priority Ranking	Human Yield (tons/mile)	Percent of banks affected by disturbance	Treatment/ BMP Strategies
BR6	18.1-32.1	Grazing, roads, revetments and riprap, and upland logging activities	1	223.62	31.2	Encourage riparian grazing BMPs and riparian buffers. Revegetate severely eroding stream banks and adjacent over bank areas.
BR7	0-18.1	Grazing, roads, floodplain development and bank armoring	6	27.25	11.5	Encourage riparian grazing BMPs and riparian buffers. Revegetate severely eroding stream banks and adjacent over bank areas.

Reach BR1 (Priority Ranking 7)

Reach BR1 is located in the uppermost watershed area, and consists of approximately 15 miles of Blackfoot River. Beneficial use support determinations for this reach concluded that 303(d) listing for sediment or habitat alterations is warranted appropriate for the uppermost mile affected by the Mike Horse tailings dam failure and other mining impacts. The restoration strategy for this reach is the integration of channel and habitat restoration activities described in Section 5.5 into the Upper Blackfoot Mining Complex restoration efforts.

Reach BR2 (Priority Ranking 5)

Reach BR2 is located upstream of Landers Fork confluence, and identified impacts to the seven mile reach include roads, revetments, livestock use, and noxious weeds. Although sediment and associated causes of impairment were not determined to be impairing beneficial uses, a number of management concerns were apparent. These include contributions of sediment from human sources and noxious weeds, which will be addressed through watershed wide conservation activities described in Section 6.1. There are no additional, reach specific restoration activities identified for this reach.

Reach BR3 (Priority Ranking 4)

Although this reach lies within the impaired reach of the Blackfoot River (Landers Fork to Nevada Creek), natural disturbance from the Landers Fork is the primary factor shaping observed conditions. As a result, there are no new specific restoration objectives for Reach BR3. Still, there are opportunities to manage the stream corridor to the benefit of the Blackfoot River in this reach. Observed problems include limited riparian cover, cleared floodplain areas, road development, noxious weeds, and riparian grazing. Fundamental restoration opportunities in this reach include enhancement of the riparian/floodplain corridor to improve riparian cover and LWD recruitment. Therefore, the watershed-wide and river corridor management strategies developed for the watershed will be applied in this reach.

Reach BR4 (Priority Ranking 3)

Reach BR4 is approximately 6 miles long, extending from the mouth of Swede Gulch to Stemple Pass Road Bridge. Restoration strategies for this reach address reductions in sediment loading from human sources and improved riparian health and function. The estimated human disturbance-related sediment yield from Reach BR4 is 100 tons/mile/year. Human disturbance affects approximately 23 percent of the eroding bank length. The reach has a third place rank in restoration priority based on this yield estimate. The identified human disturbances within this reach include floodplain development, revetments, grazing, timber harvesting, and noxious weed infestations.

To meet TMDL targets and restore in-stream conditions to full support of beneficial uses, specific restoration objectives apply to reach BR4. Therefore, this reach will be managed as a bank erosion priority focus area to address habitat alterations and increased sediment loading. This entails working with landowners to develop site-specific restoration plans to enhance the

existing native riparian vegetative community through riparian management, noxious weed control, establishment of a riparian buffer, and promote recruitment of woody debris.

Reach BR5 (Priority Ranking 2)

Reach BR5 is approximately 10 miles long, extending from Stemple Pass Road Bridge to the upper canyon area. The estimated human-disturbance related sediment production within Reach BR5 is about 195 tons/mile/year, which renders the reach a high priority with regard to restoration benefit. Identified human disturbances in reach BR5 include grazing, road encroachment, revetments, timber harvesting, and noxious weeds.

Similar to BR4, this reach will be managed as a bank erosion priority focus area by working with landowners on site-specific restoration plans. These plans will result in the restoration of the native riparian community through riparian management. In addition, there may be opportunities to improve habitat for fish by reducing width-to-depth ratios and converting extensive run environments to riffle/pool sequences. Ideally, vegetation management will be sufficient in restoring fish habitat to its potential in this reach. However, there may be opportunities where mechanical stream restoration is feasible and desirable. These will be determined on a site-by-site basis with input from landowners and fisheries managers.

Reach BR6 (Priority Ranking 1)

Reach BR6 is approximately 14 miles in length, extending from the upper canyon area downstream to the mouth of the canyon near the Highway 141. Sediment and related causes of impairment negatively affect beneficial uses warranting the implementation of restoration strategies intended to facilitate achievement of TMDL targets. Identified disturbances in Reach BR6 include grazing, road encroachment, and revetments. Sediment production estimates indicate approximately 224 tons/mile of sediment production within this reach is associated with human disturbance. Furthermore, approximately 31% of the eroding banks are affected by human disturbance. Due to the extent of human disturbance and associated yields, Reach BR6 is the highest priority reach in terms of restoration benefit. The fundamental approach to restoration in Reach BR6 is similar to that of Reach BR5, which is designed to reduce fine-grained sediment sourcing related to human impacts to improve fisheries habitat conditions downstream.

Restoration objectives for reach BR6 are similar to BR5. These include managing this reach as a bank erosion priority area and increasing the structural composition and vigor of riparian vegetation through BMPs and setbacks. More intensive restoration activities such as bioengineered bank stabilization and channel restoration may be appropriate for some portions of this reach. Feasibility of more intensive interventions will be determined on a site-specific basis using input from landowners and fisheries managers.

Reach BR7 (Priority Ranking 6)

Reach BR7 is approximately 18 miles in length, extending from the Highway 141 Bridge to the Nevada Creek confluence. Restoration strategies will facilitate achievement of TMDL targets and load allocations. Identified human disturbances in the reach consist of grazing, road

encroachment, and revetments. An estimated 27 tons/mile of sediment produced in the reach is associated with human disturbance factors.

Ostensibly, successful restoration of Reach BR7 will be achieved largely through the realization of sediment load reductions upstream. In addition, prescribed restoration activities in this reach will be based on its designation as both a bank erosion priority focus area and woody debris recruitment focus area. This designation requires working with landowners on restoration plan for site-specific management strategies to enhance riparian condition and function. Enhancement of in-stream habitat for fish will occur through promoting recruitment of large woody debris through riparian management. Alternatively, placement of woody debris is an option to promote formation of pools thereby decreasing the dominance of glide habitat. As with other mechanical interventions, landowner involvement and input from fisheries managers will guide these decisions.

Landers Fork

Natural factors were determined to be the overwhelming influence on the Landers Fork. However, there are still opportunities to mitigate the effects of human activities on the Landers Fork and ultimately the Blackfoot River. Because Landers Fork is such a significant natural sediment source, this area will be handled a High Sediment Source Area with special management and monitoring strategies developed to protect the natural floodplain and to minimize human-induced erosion in the high volume sediment delivery area.

6.3.2 Arrastra Creek

USFS monitoring segments Arrastra Creek into three sub-reaches that extend from the confluence with the Blackfoot River upstream approximately 5 miles (Table 6-4). Current conditions within Arrastra Creek warrant development of a sediment TMDL. Identified impacts within this system include excess bedload in the channel cross section resulting in aggradation and flow infiltration; riparian clearing, noxious weed infestations, potential culvert conveyance insufficiencies, and fine sediment deposition (Table 6-4).

Restoration activities for Arrastra Creek include management of both upland vegetation and stream corridor management activities. The sediment model described in Appendix M provides justification for careful management of upland vegetation. This model identified the Arrastra Creek sub-watershed as having significant area at high risk of sediment production and delivery. Consequently, the Arrastra Creek watershed will be managed as a high sediment risk area.

Other specific restoration activities will be developed in conjunction with landowners along the stream corridor. Activities will include development and implementation of plans to address sediment through riparian protection, revegetation, riparian BMPs, and replacement of culverts to ensure adequate sediment/flow conveyance. In addition, encouragement of sufficient riparian buffers is warranted for Arrastra Creek. The excess bedload condition within Arrastra Creek is not associated with bank erosion and in-channel sediment sourcing. Field documentation of both excess bedload and active riparian clearing suggests that the process of sediment interception by vegetation has been impaired within the riparian zone of Arrastra Creek. Therefore,

implementation of no cut riparian buffers along with other BMPs will likely restore beneficial use support in Arrastra Creek.

Table 6-4. Identified Impacts and Recommended Restoration Strategies, Arrastra Creek.

Major Reach	River Miles	Identified impacts	Treatment Strategies
AC1	2.0-4.7	Excess bed load, culvert blockages, noxious weed infestations, fine sediment deposition, and bank instability	Implement weed management plan. As necessary to achieve flow/sediment conveyance, replace/modify culverts.
AC2	0.75-2.0	Excess bed load, riparian clearing, and noxious weed infestations	Implement weed management plan. Encourage riparian buffers.
AC3	0.0-0.75	Excess bed load, noxious weed infestations, and high sediment loads	Implement weed management plan. Encourage riparian buffers.

6.3.3 Poorman Creek

The primary identified degraded conditions on Poorman Creek include noxious weed infestations, fish passage barriers, placer mine spoils and valley bottom disruption, landscaping and riparian clearing, grazing impacts, siltation, and dewatering (Table 6-5). Conditions on Poorman Creek warrant development of TMDL for sediment, and significant additional opportunities exist for stream restoration and improvement of channel/floodplain function.

Restoration activities planned for Poorman Creek address the various limiting factors identified for this stream. First, Poorman Creek will be addressed as a riparian focus area where the Blackfoot Challenge and agencies will work with landowners to improve livestock grazing and other activities that have a negative effect on riparian vegetation. In addition, reaches disturbed by placer mining, restoration activities may include mechanical restoration of a stable channel configuration, as is feasible following a cost-benefit analysis. Efforts to address dewatering in Poorman Creek have been ongoing and involve working with irrigators to increase water use efficiency to maintain in-stream flows.

Specific activities associated with placer mining and riparian focus area designation are as follows. Within the riparian corridor, strategies based upon weed control, riparian grazing BMPs, and no-cut timber buffers, should facilitate riparian recovery. In Reach PC4, impacts include extensive placer mining and placer spoil placement along the riverbank. Within this reach, EMAP data indicate that pool habitat encompasses less than 5 percent of the assessed channel length. The lack of pool habitat in Reach PC4 is likely associated with placer mining and spoils accumulations on the riverbank. Historic mining of the active channel bed has resulted in destruction of pool environments as well as isolation of floodplain area behind the spoils.

Consequently, restoration strategies in Reach PC4 should include a reconfiguration of the channel cross section and profile to increase geomorphic complexity, which would include the construction of pool environments and incorporation of large woody debris.

Table 6-5. Identified Impacts and Recommended Restoration Strategies, Poorman Creek.

Major Reach	River Miles	Identified impacts	Treatments/Strategies
PC1	12.7-14	Noxious weeds	Implement weed management plan. Assess needs for abandoned mine reclamation.
PC2	10.5-12.7	Passage barriers and noxious weeds	Implement weed management plan. Assess and remove existing fish passage barriers.
PC3	8.6-10.5	Passage barriers and noxious weeds	Implement weed management plan. Assess and remove existing fish passage barriers.
PC4	2.3-8.6	Passage barriers, placer mine tailings, floodplain isolation, riparian clearing, grazing, heavy infestations of noxious weeds	Restore areas impacted by placer mining based on the findings and cost-benefit analysis. Encourage riparian buffers. Implement weed management plan. Assess and remove existing fish passage barriers. Encourage riparian grazing BMPs.
PC5	0-2.3	Dewatering, grazing, and noxious weeds	Implement weed management plan. Reconfigure existing diversion system to maintain in-stream flows and increase water use efficiency. Encourage riparian grazing BMPs.

In addition to these stream corridor activities, the USFS identified numerous road improvements and BMPs to reduce sediment loading from roads, increase connectivity, and improve fish habitat (Appendix K). The USFS and county are responsible for completing these activities on their roads. The Blackfoot Challenge will work with private landowners with culverts and other road features that present a sediment risk or passage barrier to streams in the Poorman Creek drainage.

6.3.4 Willow Creek

Several perturbations along Willow Creek require restoration activities to meet TMDL planning objectives (Table 6-6). These include impacts from grazing, channelization from roads, and fish passage barriers. Specific remedies to address these impacts are as follows:

- Work with private landowners to implement grazing BMPs;
- Mitigate road and bridge crossing impairment to natural floodplain functions;
- Assessment and removal of fish passage barriers;
- Assess grade stability and restore channel to provide for grade stability; and
- Where feasible, restore/enhance wetland areas to facilitate grade control.

Table 6-6. Identified Impacts and Recommended Restoration Strategies, Willow Creek and Sandbar Creek.

Major Reach	River Miles	Identified Impacts	Recommended Treatments and Strategies
WC1	2.8-6.1	Fish passage barriers, localized channel downcutting, noxious weed infestations, grazing impacts, channel encroachment by West Flesher Road	Implement riparian grazing BMPs. Evaluate potential for increasing wetland areas and beaver populations. Assess grade stability and restore channel to limit bank erosion and infiltration. Implement weed management plan. Mitigate Highway 279 and bridge impacts.
WC2	0.8-2.8	Noxious weed infestations	Implement weed management plan.
WC3	0.0-0.8	Noxious weed infestations	Implement weed management plan.
Sandbar	All	Channel instability at Highway 200 crossing	Assess needs for abandoned mine reclamation. Incorporate geomorphic channel restoration into metals mitigation strategies. Reconfigure highway crossing to improve channel stability upstream of road.

6.3.5 Sandbar Creek

Mining activities and road encroachment present alterations that require restoration on Sandbar Creek. This plan addresses channel instability resulting from channelization by Highway 279. Specific restoration strategies for Sandbar Creek include:

- Evaluation and reconfiguration/reconstruction of the channel just upstream of Highway 279 to provide sufficient conveyance under the road, to limit upstream ponding, and to develop geomorphic habitat types in the channel section that is currently ditched; and
- Incorporation of geomorphic principles into any restoration plan designed for metals to optimize that geomorphic function and biologic productivity.

Reclamation associated with mining activities is covered in the metals TMDL (Hydrometrics et al., 2003).

SECTION 7.0

ADAPTIVE MANAGEMENT

Adaptive management has been defined as “an innovative technique that uses scientific information to help formulate management strategies in order to ‘learn’ from programs so that subsequent improvements can be made in formulating both successful policy and improved management programs” (Halbert, 1993). The National Research Council strongly recommends the adaptive approach for TMDL development as a means to make progress toward achieving water quality goals while relying on monitoring and experimentation to reduce uncertainty (Natural Research Council, 2001). Moreover, adaptive management is an important component of TMDL development and implementation in Montana. Water quality restoration planning and TMDL development efforts throughout the Blackfoot Headwaters Planning Area will benefit from the adaptive approach to manage costs and achieve success.

A significant source of uncertainty concerns the inherent variability of natural conditions in headwater environments. High variability limits the statistical certainty in making decisions. Climatic conditions can also influence certainty. For example, much of Montana has been experiencing prolonged drought. This could influence both vegetative parameters and streambed siltation over the short-term. Wildfire and floods are other types of natural occurrences that have the potential to shape conditions in the watershed for decades or longer. For example, the effects of the 1964 flood on the Landers Fork provide an example of the extent and duration that natural events can have on streams since impacts are still evident (Appendix I).

Given the realities of human resource and budgetary constraints, watershed restoration plans must continue despite a degree of uncertainty. The adaptive management approach lends itself to this scenario as it involves continued monitoring and refinement of targets based on new information. Therefore, the monitoring approach developed for the Blackfoot Headwaters Planning Area was designed to provide the feedback necessary to evaluate both the relative contributions of sediment from various sources and the efficacy in the implementation plan in achieving water quality goals.

7.1 Adaptive Management Approach to Targets

The numeric targets were developed to represent desired conditions and achievement of water quality standards. These targets represent a source of uncertainty. Specifically, there is uncertainty regarding whether the reference condition was appropriate for a given stream and whether the target(s) will be achievable. The adaptive management approach to watershed planning allows for continual evaluation of stream conditions and targets. Through this process, targets may be changed to reflect the potential of a given stream. For example, it is possible that despite implementation of all remedies, a stream does not meet its numeric target for percent fines, indicating that the target is not achievable. Alternatively, implementation of management practices may result in improvements beyond initial target criteria. This implies a greater potential than initially thought possible and can justify a more stringent target to ensure continued beneficial use support.

As part of the implementation monitoring described in Section 8.0, targets will be evaluated at least every five years. This evaluation will include a consideration of target suitability and could result in a modification to targets based on identification of more suitable reference or least impaired conditions. Also, further evaluation may identify that there is a better indicator parameter to address an impairment. Further evaluation may also identify additional impairments not effectively addressed by the existing targets. Either of these situations can justify new and/or replacement target(s) to ensure full beneficial use support concerning sediment and/or habitat impairments.

7.2 Adaptive Management Approach to TMDLs and Allocations

There are several sources of uncertainty with regard to TMDLs and allocations. A significant source of uncertainty has to do with the pollutant source assessment, pollutant load determinations, and determination of relative source impacts. This is partly due to field methods and data collection procedures, as well as modeling approaches and assumptions within models. This uncertainty is addressed to some degree by applying allocations to a number of significant loading source categories and identifying land use indicators for additional potentially significant source categories.

Another form of uncertainty has to do with the assumption that the load reductions and performance-based activities defined for each stream in Section 5.0 will result in meeting target conditions. This assumption necessitates a phased TMDL approach. Per this phased approach, as restoration efforts continue and loading reductions are achieved, implementation monitoring will occur to evaluate progress toward meeting targets as further described in Section 8.0. If it looks like greater reductions in loading or improved performance is necessary to meet targets, then a new TMDL and/or new allocations will be developed based on achievable reductions via application of reasonable land, soil and water conservation practices. On the other hand, it is possible that the stream will satisfy all targets and be considered fully supporting regarding sediment impairments, even if the TMDL and/or some load allocations have not been satisfied. This stresses the point that meeting the targets represents compliance with applicable water quality standards.

SECTION 8.0

MONITORING STRATEGY

Monitoring is an important component of watershed restoration, a requirement of TMDL development, and the foundation of the adaptive management approach. This monitoring plan for the Blackfoot Headwaters Planning Area is a multi-strategy effort designed to address specific TMDL concerns such as attainment of restoration targets and load allocations. Moreover, the monitoring strategy designed for this sediment TMDL, like other aspects of this water quality and habitat restoration plan, exceeds the programmatic requirements by incorporating the range of issues of concern to the Blackfoot Challenge. Participation of a number of planning partners including a variety of state and federal agencies, stakeholders, and other parties provides a key element to this plan that increases its value by providing a multi-disciplinary approach and local knowledge. Furthermore, this plan incorporates ongoing monitoring efforts in the basin to ensure consistency with other management concerns of the Blackfoot Challenge.

The principles of adaptive management provide a foundation for the monitoring plan presented here. A well-designed monitoring plan facilitates the adaptive approach by providing feedback on the efficacy of restoration activities, the relative contributions of sediment from various sources, and feasibility of attaining targets. Within this adaptive framework, monitoring results provide the technical justification to modify restoration strategies, numeric targets, or load allocations when appropriate. Similarly, lessons learned from monitoring results may be applied in other watersheds to facilitate other watershed planning efforts.

The monitoring strategy is broken down into two main categories: implementation monitoring and additional assessment and watershed characterization monitoring. Implementation monitoring is required to assess the effectiveness of future restoration activities, to assess whether compliance with water quality standards has been obtained by evaluating progress toward meeting restoration targets, and to assist with any adaptive management decisions as needed. Implementation monitoring to assess progress toward meeting restoration targets is required by the TMDL rules (§§75-5-703(7) & (9)), and is also an integral component of the implicit margin of safety incorporated in the sediment TMDLs developed in this restoration plan.

The additional assessment and watershed characterization category of this monitoring strategy has several potential roles. First, this category can address additional data needs for more complete delineation of sediment or habitat impaired stream segments throughout the headwaters planning area. Furthermore, additional assessment monitoring can lead to better delineation of specific sources of sediment impairment and refinement of load allocations in some drainages. Finally, additional assessment improved understanding of the aquatic life and other beneficial uses needing protection. This component of the monitoring strategy adds to the adaptive management approach and allows for continued refinement of any or all aspects of the TMDL and watershed restoration plan.

Section 8.0 monitoring activities identify where DEQ has a responsibility to perform or fund a given type of monitoring. Where a monitoring activity is not required by DEQ, the Blackfoot Challenge may pursue the monitoring activity depending on resource availability and overall

priorities. Under these conditions, the DEQ, as well as other stakeholders, may provide significant technical or financial assistance.

8.1 Coordination of Water Quality Monitoring within the Blackfoot River Watershed

Ongoing assessment, monitoring, and restoration efforts in the Blackfoot Headwaters Planning Area provide a mechanism for facilitating restoration and monitoring activities. Since the 1990s, the Blackfoot Challenge and its partners have been working to restore the health of the Blackfoot watershed through fisheries and stream restoration as well as landscape level conservation. The Clean Water Act and TMDL mandates in Montana lead the Blackfoot Challenge into TMDL planning when, in 2001, the Blackfoot Challenge established a habitat and water quality restoration committee (HWQRC) to oversee TMDL development and to ensure broad stakeholder involvement. A Water Quality Monitoring Work Group (WQWG) was created in 2002 to coordinate the network of water quality monitoring efforts in the basin and to establish a comprehensive, basin-wide water quality-monitoring program.

The Blackfoot Challenge recognizes that monitoring is a critical component of water quality and TMDL planning, implementation and evaluation. To date, the monitoring workgroup has identified four primary water quality-monitoring needs in the Blackfoot basin:

- 1) Monitor basin-wide water quality status and time trends;
- 2) Identify pollution sources and water quality impairment mechanisms for 303 (d) listed streams requiring restoration to meet state water quality standards and thus satisfy any TMDL development requirements;
- 3) Evaluate the individual and cumulative effectiveness of restoration projects; and
- 4) Establish reference information for high quality streams in the watershed that can serve as templates for restoration of impaired waters.

The Monitoring Work Group is developing and implementing a Blackfoot Watershed Water Quality Monitoring Network to meet multiple objectives including status and trends, TMDL, and restoration project monitoring. The workgroup coordinates the partnership monitoring efforts; advises on grant funds and contracts for technical work; oversees monitoring associated with TMDLs and restoration projects; facilitates technical and stakeholder involvement; and advises on monitoring education outreach and field sites. The following public and private agencies serve on the Blackfoot Challenge Monitoring Work Group: Blackfoot landowners, EPA, USGS, USFS, USFWS, BLM, DEQ, FWP, DNRC, Plum Creek Timber Company, Big Blackfoot Chapter of Trout Unlimited, Trout Unlimited, conservation districts, and TMDL Consultants.

The following list summarizes TMDL implementation goals of the Blackfoot Water Quality Monitoring Workgroup:

- Utilize the Blackfoot Challenge HWQRC and its water quality monitoring workgroup (WQWG) to coordinate implementation of the Blackfoot headwaters water quality and habitat/TMDL for sediments monitoring strategy;

- Refine and implement a Blackfoot Watershed Water Quality Monitoring Network, incorporating TMDL monitoring needs into the work program; and
- From TMDL related monitoring data evaluate targets, allocations and assess effectiveness of implementation plan in achieving water quality goals.

8.1.1 Implementation Monitoring

The objective of the implementation monitoring plan is to address three components of the sediment TMDL developed for the Blackfoot Headwaters Planning Area. These are: 1) assess progress toward attainment of the restoration targets as required by TMDL regulations, 2) assess overall progress toward meeting allocations, and 3) assess the effectiveness of specific restoration activities. The following sections detail these activities as they relate to TMDL development and watershed planning objectives.

8.1.1.1 Implementation Monitoring Focused on Restoration Targets

Implementation monitoring to assess overall progress toward meeting the restoration targets identified in Sections 5.0 of this plan will include monitoring a combination of physical stream conditions (both channel and riparian) and biological community measures. Implementation monitoring will be done at least once every five years as defined by the TMDL regulations, with additional monitoring performed as needed to ensure timely evaluation of completed restoration activities in a particular drainage. DEQ is responsible for this type of implementation monitoring although other entities may perform significant aspects of the monitoring and it is expected that the overall effort will be closely coordinated with the monitoring workgroup. The monitoring workgroup will be involved with the final overall target monitoring plan development as needed to refine target locations or other monitoring details as necessary.

Monitoring parameters and methods vary slightly according to 303(d) listed stream. Table 8-1 is a summary of minimal target compliance monitoring parameters and likely monitoring locations. All monitoring efforts are to be done using standard DEQ sampling and analyses protocols, or sampling and analyses protocols as approved by DEQ. This is particularly important for analysis of biological target conditions where a given protocol is necessary to ensure proper sample size for clinger taxa richness determinations. The existing protocol (Bukantis, 1998) involves the traveling kick net macroinvertebrate collection method and laboratory sub-sampling. As noted in Section 5.0, the DEQ may update the biological indicators and metrics used for beneficial support determinations, as well as sample and analysis protocols. These updated biological indicators, under the direction of DEQ, may replace one or more of the biological targets identified in Section 5.0.

Because local reference conditions provide the basis for some target development, monitoring may also include measurements in reference streams to ensure an appropriate baseline comparison condition. Significant environmental factors such as drought, floods, or fires can affect both reference and impaired stream conditions throughout a watershed, and may be important factors in determining target achievability. In addition, improving watershed conditions in reference streams may justify a more protective target condition based on similar

improving trend expectations within impaired streams beyond the anticipated improvements that will be achieved via meeting load allocations.

Additional assessments on streams in the Blackfoot Headwaters Planning Area may provide auxiliary information in refining targets for tributaries in the Blackfoot Headwaters Planning Area. For example, DEQ in conjunction with EPA, conducted full EMAP assessments in Keep Cool Creek, a tributary to the Blackfoot River located within the Blackfoot Headwaters as part a regional initiative. These data will become available in the near future.

In many cases, more sampling may be desirable to better measure progress or to establish an improved baseline condition. This is particularly true for the McNeil Core sampling, where yearly sampling on many streams helps establish overall watershed trends and can help evaluate relative impacts from natural events such as recent large fires in the Copper Creek and other drainages during 2003. Therefore, additional McNeil core sampling may occur within an adaptive management approach to assist in refinement of targets or evaluate the impacts of natural disturbance. Additional McNeil Core sampling is also required to track and possibly refine reference conditions as discussed in Section 5.1.1.

When evaluating target compliance, it is possible to have conditions where the median values satisfy the targets in Table 5-1, but indicate extremely low fines within the stream. This could be an indication of a different kind of impairment that could be associated with an overall reduction in appropriate spawning habitat. The assessment results do not indicate this type of human-related impairment in the system, but a lack of spawning locations for sampling or very low fines values relative to reference conditions should be a warning to evaluate further the potential cold-water fish support status in the stream.

Table 8-1. Monitoring Locations and Parameters to Evaluate Target Compliance.

Stream(s)	Parameter(s)	Location(s) ¹	Sample Method	Sample Period
Blackfoot River above Landers Fork; Mike Horse Creek; Beartrap Creek; Sandbar Creek; Willow Creek; Poorman Creek	Dynamically stable channel, functioning riparian, overall proper functioning condition, percentage of pools within anticipated range for Rosgen stream type	Blackfoot: Whole length above Upper Marsh (upper 1 mile of river); Mike Horse and Beartrap: lower reaches; Sandbar: just above highway crossing and in upper mine impacted reach; Willow: downcut reach above Sandbar; Poorman: Placer mined reaches based on results of additional benefits analyses	Proper Functioning Condition or equivalent; benchmarked cross sections with substrate type; width to depth ratio, and entrenchment ratio; sinuosity measures	Low Flow
Blackfoot River (Landers Fork to Nevada Creek); upper one mile of Blackfoot River; Arrastra Creek; Poorman Creek; Willow Creek; Sandbar Creek; Mike Horse Creek; Beartrap Creek	Macroinvertebrate & periphyton assemblages (includes clinger taxa richness data)	Blackfoot: three representative locations; Arrastra: one to two representative lower site locations; Poorman: two to three representative locations with at least one in the lower reach (PC5); Willow: one to two representative sites with at least one in the downcut reach above Sandbar Creek; other streams to be monitored in reaches with channel restoration	Standard DEQ protocol	Low Flow, summer to early fall
Blackfoot River (Landers Fork to Nevada Creek); Arrastra Creek; Poorman Creek; Willow Creek (optional)	McNeil core sampling	Existing sample locations used by Forest Service; or equivalent spawning locations;	Existing McNeil Core procedure used by Forest Service or equivalent	Low flow; post runoff (typically during late summer or fall)
Arrastra Creek; Poorman Creek	Riparian health; width to depth and any other channel related targets	Arrastra: all three reaches plus one or two representative upstream reaches; Poorman: lowest reach above spring creek and two to three upstream representative reaches	Modified EMAP, R1/R4, or an equivalent method with monitoring workgroup input	Low flow; summer to early fall
Poorman Creek; Willow Creek	49-point grid toss fines	Same locations as for riparian health measures	Grid toss or equivalent method	Low flow following runoff

1: Locations, particularly those for macroinvertebrate and periphyton sampling, are to be coordinated with similar or identical sampling to be done for metals TMDL target compliance.

8.1.1.2 Implementation Monitoring Focused on Meeting Load Allocations

The other category of implementation monitoring addresses assessments evaluating attainment of allocations. In the event that numeric targets are not met, this type of monitoring supports the adaptive framework for either refining the numeric targets or altering restoration activities geared at achieving the targets. Montana State Law (75-5-703(7) & (9)), requires that if the target-related monitoring discussed above demonstrates that water quality standards have not been achieved within 5 years after approval of a TMDL, then DEQ is required to conduct a formal evaluation. The evaluation will investigate the progress in restoring water quality and the status of reasonable land, soil, and water conservation practice implementation to determine if:

- a) the implementation of a new or improved phase of voluntary reasonable land, soil, and water conservation practices is necessary;
- b) water quality is improving but a specified time is needed for compliance with water quality standards; or
- c) revisions to the TMDL are necessary to achieve applicable water quality standards.

To facilitate this review, the DEQ may need to evaluate progress toward meeting load allocations presented in Section 5.0. This would be coordinated with ongoing Blackfoot Challenge monitoring activities discussed below.

The Blackfoot Challenge is concerned with long-term land and water management throughout the watershed and is committed to evaluating impacts associated with changes in land use, water use, fires, floods, and droughts. The Blackfoot Challenge, through its Habitat and Water Quality Restoration Committee, will take a leadership role in reviewing major changes in the watershed, evaluating progress in meeting allocations, and satisfying management strategies. These activities will subject to available funding and overall priorities of the Blackfoot Challenge and will be carried out as part of DEQ's 5-year assessment. Potential focus areas are listed below; many of which will likely require use of aerial assessment methods for evaluation purposes.

- Elevated sediment yield areas.—Monitor the relative changes in high and low cover percentages associated with timber harvest or other land clearing activities within each drainage; also monitor grazing and timber harvest impacts in these high risk areas since a lack of grazing or timber harvest BMPs can significantly increase sediment erosion.
- Equivalent clearcut area (ECA).—Monitor overall ECA values within drainages and calculate potential impacts on peak flows via increased water yield.
- Bank erosion focus areas.—Monitor changes in stream bank erosion from human impacts in focus areas. This may include a statistical sampling or a focused effort to identify all stream banks with the potential for reduced erosion and then tracking progress (BMP implementation) toward reducing erosion rates for these bank locations. An inventory similar to what was done on the Blackfoot River may be repeated to some extent, although it would likely be in a streamlined form.
- Dewatered streams.—Monitor changes in flows in de-watered streams, particularly Poorman Creek.
- Forest roads.—Work with the Forest Service and other landowners to evaluate progress toward reducing sediment erosion at road crossings, to upgrade undersized culverts to pass

increased flood flows and to also provide fish passage where desirable; track floodplain passage improvements on Forest Service road crossing over Willow Creek.

- County and subdivision roads.— Work with stakeholders to implement erosion BMPs, reduce chance of culvert failure, and reduce the potential for undesirable fish passage barriers.
- Stream restoration.—Track progress on restoration of streams impacted by Upper Blackfoot Mining Complex mining activities in coordination with metals TMDL implementation; track evaluation of restoration efforts on placer-mined area on Poorman Creek; track restoration of Sandbar Creek.
- Riparian zones.—Monitor changes in development along riparian zones throughout the watershed; ensure maintenance or improvement of riparian health through grazing BMPs or other protective measures

To help achieve some of the above allocation/implementation monitoring, the Blackfoot Challenge, through its Conservation Strategies Committee will maintain a GIS Database Library of key values and analyze changes in these values over-time including:

- Community values such as rural intactness (grazing acres and fallow acres), population demographics (population and households), economics (employment and income), and land statistics (parcel size, land values, growth rates, developable lands, viewsheds (elevation, river);
- Agricultural values such as timber (commercial, coverage), range land (native grass and scrub land), croplands (pasture/hay - grass, legumes, mixes for livestock, small grains, NRCS soil data, public vs. private lands; and
- Biological values such as buffers and wilderness areas and migration corridors, vegetation types such as riparian (woody), wetlands and lakes, and native grasslands; wildlife components such as big game species (elk, moose, bighorn sheep, white-tailed deer, mule deer), threatened and endangered species (bald eagles, grizzly bears, wolves, lynx, bull trout); and native fish (westslope cutthroat trout).

The Blackfoot Challenge, through the Monitoring Work Group, will track and report on changes in upland and stream conditions and assess the overall health of the watershed through:

- Status and Trends monitoring project;
- State of the Basin Report, and other focused evaluations.

The DEQ will work closely with the Blackfoot Challenge as part of the monitoring work group to ensure coordination of all TMDL implementation monitoring under DEQ's responsibility.

8.1.1.3 Implementation Monitoring Focused on Specific Restoration Projects or Activities

There will be a periodic review of the effectiveness of specific restoration activities and actions in achieving TMDL plan objectives. Many of these may be covered as part of the overall tracking of allocations discussed above, although in some cases there may be expanded site specific monitoring to further evaluate water quality improvements. The site specific monitoring

will often be required as part of the project funding agreement, and would typically be performed by the consulting firm or agency implementing the project, often in coordination with the Blackfoot Challenge, the DEQ, or another involved agency such as FWP. Examples include:

- Verifying and quantifying riparian improvements and reductions in bank erosion in areas where projects such as rotational grazing BMPs have been implemented.
- Monitoring channel conditions over time to evaluate the success of specific in-stream channel restoration activities. This can include pool and other habitat measures as well as measuring the success of riparian improvements. Photo points and cross-sectional measures can also provide critical data.
- Evaluate success and overall maintenance of road BMPs.
- Monitor changes in aquatic life and fisheries populations in restoration reaches to evaluate success.

8.2 Additional Assessment and Watershed Characterization Monitoring

As previously discussed, additional assessment and watershed characterization monitoring may provide useful information in an adaptive management framework. For example, these monitoring activities can address additional data needs for more complete delineation of sediment or habitat impaired stream segments throughout the headwaters planning area. Furthermore, supplemental monitoring may result in better delineation of specific sources of sediment impairment or refinement of load allocations in some drainages. Finally, these additional monitoring activities may provide an improved understanding of the aquatic life and other beneficial uses to be protected. The following sections describe potential assessment activities prioritized as high, medium, or low monitoring priorities.

8.2.1 High Priority Monitoring Opportunities

During this TMDL and water quality and habitat restoration improvement planning efforts, a number of supplemental monitoring activities emerged as high priorities. These included additional assessments of biological and water chemistry, and evaluation of other potentially limiting factors such as fish passage barriers and dewatering. Finally, natural disturbance such as wildfires may have a lasting effect on water and habitat quality. This sub-section details plans to monitor these high priority supplemental monitoring concerns.

- Fish communities are key water quality indicators and a designated beneficial use. Montana Fish, Wildlife & Parks will monitor fish populations according to their established schedule and as additional funding allows. Fisheries investigations may include population estimates, redd counts, and fish movements through the basin. Fisheries evaluations will assist in assessing the effectiveness of restoration activities as part of an adaptive approach, but are not required under the 5-year DEQ assessment.
- Nutrient enrichment was a probable cause of impairment on the 1996 303(d) list for the Blackfoot River. The available data did not confirm this impairment; however, additional data would have been useful in strengthening this determination.

Therefore, to provide better documentation of beneficial use support associated with nutrients, DEQ will work with the Blackfoot Challenge and the monitoring work group to evaluate nutrient parameters in the section of the Blackfoot River above Landers Fork. Nutrient monitoring may also be pursued in other locations, as is currently being done in the Blackfoot River above the mouth of Nevada Creek, to support nutrient TMDL development in lower reaches of the Blackfoot River and for the Clark Fork River.

- Undersized culverts and culvert failures are a substantial concern throughout the Blackfoot Headwaters Planning Area. Further investigation would facilitate identification of undersized culverts and fish passage barriers that restrict fish movement or are a potential source of sediment loading. This should be a responsibility of the specific landowner for the crossing(s) of interest, although assistance from MFWP in evaluating the potential for undesirable passage barriers will be of considerable benefit. Not all culverts and locations are high priority, but many locations on key migratory streams or in areas with a potential for a high sediment load should be treated as high priority.
- Evaluation of flow regime in Landers Fork also emerged as a monitoring priority in this planning effort. Evaluation should focus on the role of land use, aggradation following a large flood, and mechanical channel alterations following flood events in influencing maintenance of surface flows. Historical data indicate that Landers Fork, near the lower bridge, used to go dry whereas that does not appear to be the situation in recent years. The objective of evaluating the surface water hydrology is to determine management strategies to promote maintenance of surface flows to support the resident fishery and sustain connectivity to Copper Creek for spawning bull trout.
- Evaluation of large woody debris and pool formation over time is a high priority for areas impacted from flooding or land uses that have limited large woody debris recruitment to several streams. For example, the Landers Fork and several other assessed stream reaches had relatively low values of large woody debris. This information will provide a better understanding of reference conditions and fish habitat capabilities as well as potential impacts from historical and ongoing land uses.
- The wildfires of 2003 resulted in another high priority monitoring activity for the Blackfoot Headwaters Planning Area. In the Copper Creek drainage, over 18,000 acres burned with the majority rating within the high severity category. The impacts of these fires on sediment loading should be closely monitored to evaluate fire related impacts, particularly on beneficial uses and other target indicators developed as part of the sediment TMDLs downstream. This will not only help with implementation of this TMDL, but could also help with TMDL development in downstream areas below Nevada Creek (the Middle and Lower Blackfoot TMDL Planning Areas).

8.2.2 Medium Priority Monitoring Opportunities

In addition to the high priority supplemental monitoring activities described above, a number of lesser priority monitoring opportunities emerged. These activities have the potential to refine load allocations and delineation of sediment sources in the watershed. The medium priority monitoring options will be addressed contingent on acquisition of funds and balanced with other planning priorities in the basin.

- With evaluation of potential upland sources of sediment production, Moose Creek and Sauerkraut Creeks emerged as areas with substantial potential to produce and deliver sediment. Furthermore, local fisheries professionals noted highly turbid flows in the streams during runoff events. Note that both of these streams have had evidence of significant land clearing. Furthermore, Sauerkraut Creek has also had significant recent placer mining. DEQ will conduct monitoring of these two creeks for possible 303 (d) listing as sediment impaired streams, although any such assessment work will be prioritized in recognition of DEQ's current assessment and TMDL development workload.
- Another medium priority monitoring activity is evaluation of sediment contributed from eroding banks. This would address a source of uncertainty in estimating sediment loads from bank erosion is related to bank retreat rates in the upper Blackfoot River. Consistent with the adaptive management approach described above, bank pins at several representative banks could be used to evaluate bank retreat rates on severely loading banks on the main stem of the Blackfoot River. This would allow for calibration of sediment load allocations associated with human impacts on eroding banks along the Blackfoot River.
- Evaluation of sediment contributed from tributaries is another medium priority monitoring activity that would enhance the ability to model sediment inputs in the basin. This would address the uncertainty associated with predicting sediment loads from natural and human sources, a difficult endeavor in the Blackfoot Headwaters Planning Area due to a lack of hydrologic data as well as measurements of suspended and bed load. Sampling of sediment loads during runoff conditions would allow for an estimation of the sediment loading and would also provide data that could be used for calibration of the SSDM model.
- Additional stream habitat assessment work, similar to the modified EMAP and bank erosion inventories, would also enhance the understanding of stream conditions in the Blackfoot Headwaters Planning Area. Areas of interest would include possible reference or "least-impacted" tributaries in the watershed. Also, additional stream habitat assessment work would help refine riparian and channel width to depth targets within Poorman Creek and Arrastra Creek. Additional targets associated with percent pools or other important fish habitat indicators could be desirable in these and possibly other streams. Much of this work can be addressed as part of the five-year implementation monitoring focused on restoration targets.

Finally, the Blackfoot Challenge working with the Monitoring Work Group will look for opportunities to fund ongoing monitoring to answer uncertainties in the Sediment TMDL and other program areas. These efforts may not always be required for TMDL monitoring, but would improve our understanding of the Blackfoot Headwaters system. The above list is not intended to cover all such monitoring activities, and it is anticipated that additional monitoring projects will be identified through time and that many of these projects may be of a relatively high priority in comparison to those listed above.

SECTION 9.0

PUBLIC INVOLVEMENT

Public involvement is a component of TMDL planning efforts supported by EPA guidelines and Montana State Law. Public involvement is desirable to ensure development of high quality, feasible plans and increase public acceptance. The Blackfoot Challenge has provided for public involvement throughout the planning process to address public and private landowner needs and concerns. The Blackfoot Challenge will encourage ongoing involvement by the public and stakeholders in the implementation of the Blackfoot Headwaters Water Quality and Habitat Restoration Plan.

Activities that have facilitated public involvement include mailings, press releases, and meetings to apprise stakeholders in the Blackfoot Headwaters Planning Area about the progress of the project. An open house in Lincoln held prior to the 2002 field assessment provided time for stakeholders to learn first-hand about the project and was used to solicit comments regarding community and stakeholder concerns. In addition, the draft plan was available on the Internet to solicit comment and review from the Blackfoot Challenge Habitat and Water Quality Restoration Committee and stakeholders.

An additional opportunity for public involvement is the 30-day public comment period following acceptance of the TMDL plan by DEQ. This public review period extended from December 26, 2003 through January 30, 2004. A public meeting on January 21, 2004 in Lincoln, Montana provided an overview of the Blackfoot Headwaters Sediment TMDL and an opportunity to solicit public input and comments on the plan. Public response was supportive of the plan. Participants were encouraged to provide any written suggestions to DEQ for incorporation in the plan as appropriate. Appendix N includes the public comments received and the DEQ response to these comments.

DEQ provides another opportunity for public comment during the biennial review of the 303(d) list. This includes public meetings and opportunities to submit comments either electronically or through traditional mail. DEQ announces the public comment opportunities through several media including press releases and the Internet.

SECTION 10.0

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